DOCUMENT RESUME

ED 147 222 SO 010 466

AUTHOR Spicer, Brian, Ed.; And Others
TITLE Man and Space. The Global System, Level 1.
PUB DATE 72
NOTE 169p.; For related documents, see SO 010 467-468; Figures, photographs and maps may not reproduce clearly due to poor reproducibility of original document
AVAILABLE FROM Jacaranda Press, 65 Park Road, Milton, Queensland, Australia 4064 ($6.00)

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS Agriculture; Area Studies; Design Needs; Earth Science; Ecological Factors; Educational Objectives; *Environmental Education; *Geographic Concepts; *Geography Instruction; Industrialization; *Learning Activities; Maps; Neighborhood; Physical Environment; Physical Geography; Secondary Education; Skill Development; *Social Studies; Teacher Developed Materials; Textbooks
IDENTIFIERS *Australia

ABSTRACT

Part of a geography series which stresses understanding of the environment through mastery of specific skills and concepts, the secondary level textbook examines environmental systems as they exist at present. A system is defined as one of a large number of elements (people, cities, rocks, soils, air, clouds) which make up the environment. Although developed for use in Australian secondary schools, the material and activities can be adapted for use in other countries by replacing Australian examples with other examples more relevant to students. The text comprises 15 chapters, 14 of which describe a specific system including the following: desert, barrier reef, swamp, farm, cattle station, mine, bakery, communication, urban and rural neighborhoods, and a garage repair shop. Skills and objectives are listed in the introduction and tests are included throughout the text. The format of each chapter generally includes background information, illustrations, maps, graphs, and discussion questions. Learning activities suggested to help students observe elements of a system and analyze spatial relationships between them include role playing, surveys, library research, map work, class reports, debates, and field trips. The final chapter suggests questions and activities for evaluating student skills and understanding of textual material. (Author/DB)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED147222

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

The Global System Level 1

MAN AND SPACE

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

B. J. Spicer

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

SO 010466

MAN

CONTRIBUTORS

G. S. Blanch
Melbourne University (student)

D. D. Harris
Kings College, Adelaide

J. D. Hill
Toorak College, Mount Eliza, Vic.

P. G. Irwin
University of Newcastle

K. L. Marriott
Monash Teachers College, Melbourne

N. Thornton
Portland High School, Vic.

W. J. Traill
Morwell High School, Vic.

I. R. Wilson
Koonung High School, Vic.

The Global System
AND SPACE

EDITORS

Brian Spicer
Lecturer in Education,
Monash University, Melbourne

Michael Achurch
Geography Master,
Scotch College, Melbourne

Kevin Blachford
Research Assistant,
Curriculum and Research Branch, Vic.

William Stringer
Lecturer in Curriculum Studies,
Melbourne College of Education

The Jacaranda Press

First published in 1972 by
JACARANDA PRESS PTY LTD
46 Douglas Street, Milton, Q.
32 Church Street, Ryde, N.S.W.
37 Little Bourke Street, Melbourne, Vic.
142 Colin Street, West Perth, W.A.
154 Marion Road, West Richmond, S.A.
57 France Street, Auckland, N.Z.
P.O. Box 3395, Port Moresby, P.N.G.
122 Regents Park Road, London NW1
70A Greenleaf Road, Singapore 10
P.O. Box 239, Makati, Rizal, Philippines

Typesetting by Dudley E. King Linotypers Pty Ltd, Melbourne
Printed in Hong Kong
Reprinted in Hong Kong 1973

© B. Spicer, M. Achurch, K. Blachford, W. Stringer 1972

National Library of Australia
Card Number and ISBN 0 7016 0561 8

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of the publisher.

Contents

Acknowledgments vii
Introduction 1
1 Grasshopper country: the desert fringe 7
2 The Barrier Reef 15
3 A swamp environment 25
4 **The farming system:** a market garden 32
5 A dairy farm 41
6 The beef cattle industry 57
7 **The mining system:** Norseman, a 'robber industry' 65
8 Christmas Island 72
9 **The industrial system:** a bakery 80
10 Newspaper delivery, Portland 87
11 A garage: 'the repair shop' 90
  Activities on movement 98
  What is a neighbourhood? 98
12 **The neighbourhood system:** Elizabeth, an example of planning 100
13 Sale: a large-scale rural neighbourhood 117
14 Are all urban neighbourhoods the same? 127
  How to do your own fieldwork 142
  My ideal town 146
15 Evaluation 148
Appendix 157
  Metric conversion factors 157
  Topographic map legends 158
Index 159

Acknowledgments

The editors and contributors are greatly indebted to a number of persons and organisations for their valuable assistance. Besides the sources acknowledged in the text, they wish to express their gratitude to the following:

CSIRO, Belmont, Queensland
Mr J. S. Hatherly, Mirboo North, Victoria
BPC, Christmas Island
W. D. Leslie Pty Ltd, Sale, Victoria
Sale Chamber of Commerce
D. F. Beckworth, Scotch College, Melbourne
Dingley Market Garden, Victoria
Western Mining Corporation Ltd
Opie's North Bakery Pty Ltd, Salisbury, S.A.
Shell Company of Australia Ltd
Mr Bruce Howard, Hodder's Service Station, Melbourne
Directorate of Military Survey, Canberra
Australian Tourist Commission, Melbourne
The *Age,* Melbourne
South Australian Housing Trust, Adelaide
Trustees of the Mitchell Library, Sydney
Nan Kivell Collection, National Library of Australia, Canberra

Introduction

TO THE STUDENT

This sort of project has never been done before. We have written it for you, and we hope and think you will find it interesting. We are all teachers, and we are naturally very concerned to ensure that working with this project will be an exciting, stimulating, enjoyable and valuable experience for you.

We would like to hear your views and ideas about this project — perhaps the ways in which you would like to modify it so that it becomes more interesting for students of your age and interests. (You can always give your ideas to us by writing to the publishers.)

You may ask just what you should achieve by studying geography at this level using this book. This project will help you to build up mastery of many useful skills and ideas which will help you to understand the world about you. Some of these skills and ideas are listed on pages 4-5. You may like to read these and perhaps tick them off as you feel you achieve them. There are several tests incorporated in the text which will help you find out just whether or not you have achieved them. We sincerely hope you will, and we wish you success in your efforts.

Brian Spicer
Michael Achurch
Kevin Blachford
William Stringer

TO THE TEACHER

This is *The Global System* Level One — a very new sort of geography project for use in Australian secondary schools. We hope that your students will enjoy it and gain from reading it, and from using the variety of material (photographs, maps, statistics, descriptive passages, exercises, etc.) contained within it.

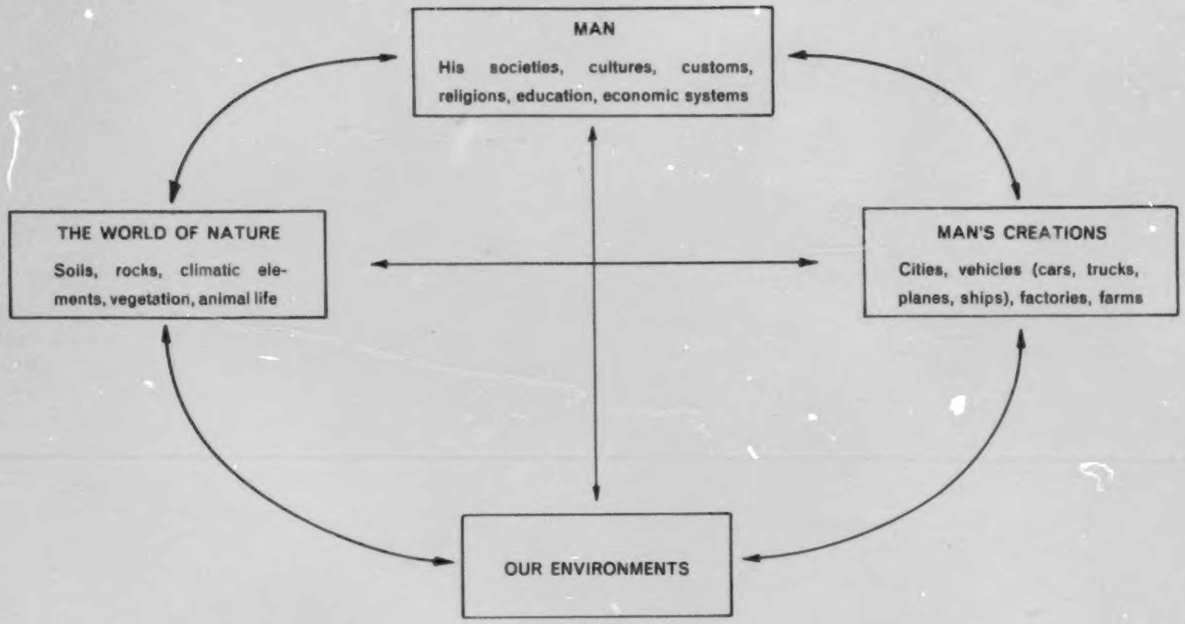
The book includes a number of specific studies — some, for example the study of the Barrier Reef, are concerned with systems (we shall come back to this word in a moment) in which man is not usually a part; some, for example the studies of the dairy farm and the cattle station, deal with spatial systems in which men are present, while others, for example the studies of the bakery, the garage and the urban neighbourhood, introduce the notions of industrial and urban systems.

To begin, let us consider the meaning of the word 'system'. What does it mean to the geographer? The first thing to understand is that we all live in a huge system, the environmental (or perhaps the global) system, and this system is made up of an enormous number of different elements or parts (people, cities, rocks, soils, sea, air, clouds — see the figure on page 2). All of these elements are important in the working of the system — a change in one element affects the operation of the other elements and therefore affects the whole environment, the whole system. Now, as geographers we cannot claim to be able to study all aspects of these elements—we must draw on the knowledge and experience of chemists, geologists and hundreds of other people in order to study all aspects of all elements in the system. As geographers, we are most interested in the location of these elements in space — that is, their arrangement over the surface of the earth. Also, we are not always concerned with the total surface of the earth at the one time — we are often very concerned with small areas (with small sections of earth space), and with small environmental subsystems. Farms, factories, urban neighbourhoods and the like are examples of these smaller spatial subsystems. We shall, in this project, study a number of these systems — identify the elements, learn how to describe them, and examine how they work and fit together within the system (as in the figure illustrating the farm system on page 3).

Each chapter is devoted to a specific type of system; a number of its elements are identified, and tasks are suggested for the student to observe these elements and to analyse the spatial relationships between them. These tasks provide a means

8

THE GLOBAL SYSTEM


MAN
His societies, cultures, customs, religions, education, economic systems
THE WORLD OF NATURE
Soils, rocks, climatic elements, vegetation, animal life
MAN'S CREATIONS
Cities, vehicles (cars, trucks, planes, ships), factories, farms
OUR ENVIRONMENTS

by which the student can interpret the data before him — but they should not be regarded as all-inclusive, nor are they necessarily the best tasks for every student in a class. The teacher should, indeed must, feel free to modify, accept or reject the tasks that are provided so that the freedom he enjoys as teacher is maintained. Certainly, if the order of undertaking the studies is varied from that presented in the book (and this should be encouraged), then the tasks will also need to be modified, especially in terms of the level of difficulty of language included and the skills required.

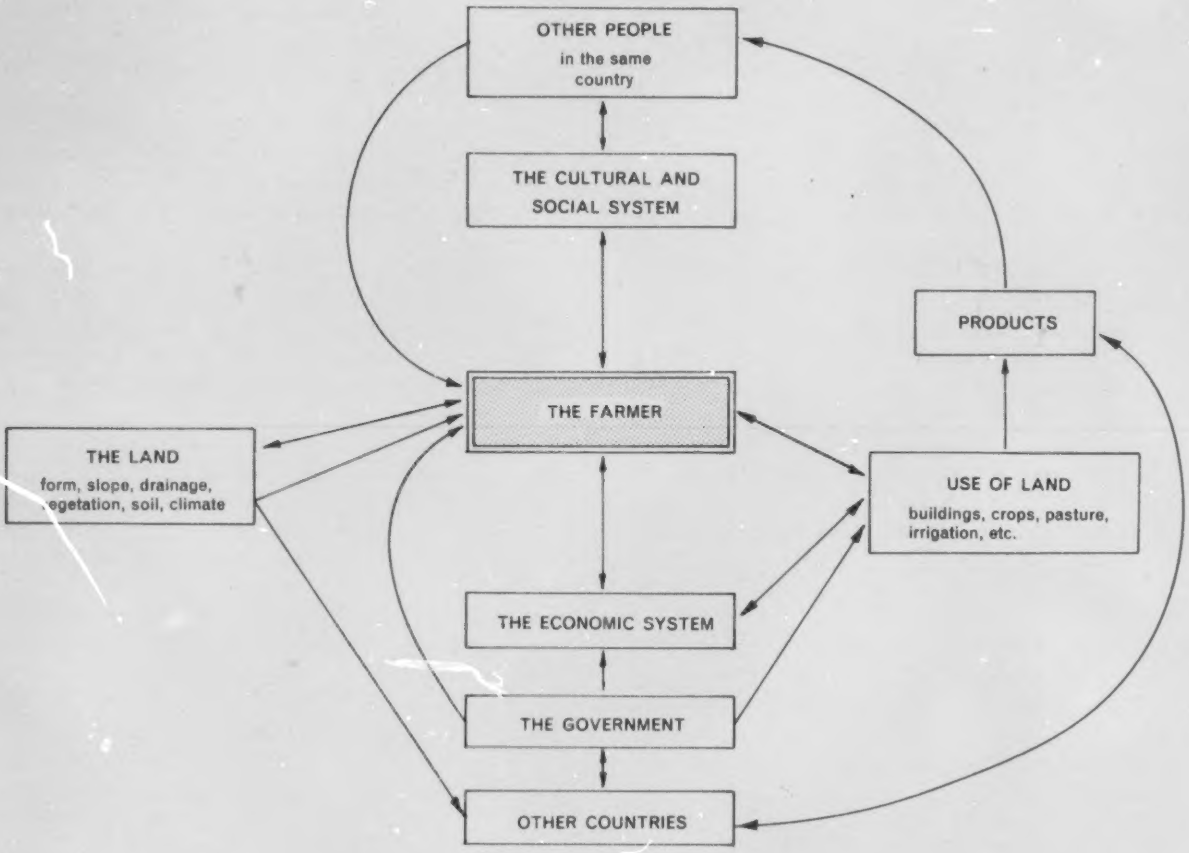
Throughout this project, there are a number of simulations and games provided as a basis for student activity in the classroom — there are games in which students adopt certain roles, and then discuss relevant issues and make decisions on specific problems. These games are a most vital strategy in that they are a positive means of achieving the objectives of attitudinal development outlined later in this introduction.

Teachers may initially find difficulty in handling a situation in which there are no correct answers, but this is an essential element of many situations — on a number of occasions the final decision represents a value judgment dependent on the values held by the person(s) involved. We should avoid any attempt to force the final decision in one or another direction. The teacher's task is to ensure that the issues are discussed and analysed in a balanced fashion.

We have no section devoted exclusively to fieldwork in the local area, but this is not meant to convey the impression that we are unconcerned with this aspect of geography. We are fully committed to the principle of fieldwork as a basic element in geographical study. However, we do not believe that the initial activity in the first form geography course ought to be a detailed survey of the land use of the local neighbourhood. We have followed the principle of introducing fieldwork where it seems to be most appropriate in developing the skills and concepts required and desired. For example, a survey of local land use is not suggested until the student is involved in the analysis of the neighbourhood studies presented later in the book. Of course, the teacher is free to deviate from this pattern, but we do commend our approach as a viable alternative to the traditional pattern.

So far we have referred to several strategies — simulation and fieldwork — which clearly have a place in this course. But there are a number of other aspects which should be mentioned at this stage. Firstly, the order in which the studies are presented follows an order derived from the activities of man in the system. Our first studies of Grasshopper Country, the Barrier Reef and the

THE FARM SYSTEM


OTHER PEOPLE
in the same country
THE CULTURAL AND SOCIAL SYSTEM
PRODUCTS
THE FARMER
THE LAND
form, slope, drainage, vegetation, soil, climate
USE OF LAND
buildings, crops, pasture, irrigation, etc.
THE ECONOMIC SYSTEM
THE GOVERNMENT
OTHER COUNTRIES

Freshwater Swamp involve systems in which people are not a very active element. This does not mean that people never enter the system, but rather that their influence is intermittent and, compared to their role in the operation of many other systems, rather slight. Our later studies cover systems such as farms in which [illegible] an individual is a vital element, while the neighbourhood studies towards the end of the book introduce man as a mass element in the system. Throughout these studies, various skills and concepts are introduced and developed in pursuit of the objectives set out later in this introduction.

Secondly, we would argue for more attention to individual progress, rather than for the dominance of the class average as a norm. To this extent our exercises must be adapted to suit the requirements of individual students. This, of necessity, is the teacher's problem.

Thirdly, where new terms are introduced in the text, two approaches have been adopted: the definition is provided within the text, or no definition is provided and it is left for the teacher to direct the students — either by giving the definition himself, or by directing their enquiry so that they reach the definition of their own accord. A similar pattern is adopted with regard to specific skills.

The fourth, and perhaps the most important of all issues, relates to the objective of attitude development. We acknowledge quite readily the difficulty of this task — but education is changing, and with this change has come a renewed appreciation of, and interest in, the need for value formation. As a result of these changes it has become essential for teachers of all subjects, geography no exception, to regard the student's affective development as at least as important as his cognitive development. For this reason we believe that the discussion of issues in which value judgments are essential for decision-making is an important requirement of any good geography course. This is relevant to Level One, although it is not as developed at this level as in subsequent books of the series. Once again, we believe that the role of the teacher should be to ensure a balanced weighting of the issues, rather than the attainment of a particular pre-set conclusion.

Finally, at this stage, we should point out that a number of evaluation tasks have been set for the student. The aim is to ensure adequate mastery of the concepts and skills required to enable him to undertake future learning with confidence. Evaluation is not included with the intention of enabling the teacher to give the student 'a mark', but to enable him to see whether or not the student has achieved the objectives set for that stage of the course. We consider successful learning at this level to be a fundamental requirement for future interest, enthusiasm and success.

We have written quite a deal about objectives in general, but what are the particular objectives that we had in mind when preparing this volume?

Objectives

These are of three basic types:

- *cognitive* — the development of various mental skills, for example the ability to comprehend, analyse, interpret, synthesise and evaluate data
- *affective* — the development of various attitudes deemed to be worthwhile and desirable in a member of society
- *psychomotor* — the development in the student of certain basic skills important to his study of geography and important to him as an operative member of society.

Cognitive objectives

1. Specific knowledge of a variety of environments, together with basic knowledge of the form and process of formation of a number of landform features (e.g. river plains, atolls, coral reefs), knowledge of specific minerals, vegetation types, cloud types, etc., and knowledge of a variety of human activities and features.

2. Abilities to analyse and interpret data, whether in written, map, graph or statistical form, within the framework of certain vital concepts:

Location — elements in the system seen as occupying points in space; the concept of site

Distribution — the pattern caused by the location of a number of elements described in terms of density (light or heavy) and pattern (concentrated or dispersed)

Scale — the ability to use scale as an analytical tool; map reading

Movement — flows occurring within the system from point to point (people, cars, water in a stream, etc.), and from time to time (the seasonal flow); types of movement, whether animate or inanimate; the ability to identify sequence

Direction — an ability to orientate according to a compass grid

Association — the occurrence together and mutual impact in space of several elements (roads, factories, raw materials, etc.); this should be seen only as an association, not as a causation

Boundary — the notion that many spatial systems have quite definite limits

Central place — the ability to recognise the significance of this on a microscale, rather than a macroscale (e.g. farmstead buildings in relation to fields)

Area — the ability to generalise about a particular section of earth space so that the unity of that section is clearly indicated

Resources — the need to appreciate that elements should be seen as resources available to man.

3. The ability to hypothesise (to suggest possible reasons) to account for particular locational patterns or attitudes. Necessarily this requires:

The ability to observe and describe, and to record the data obtained from observations; observation may be developed in the field or in the classroom using photographs, maps, etc.

The ability to record data in a variety of forms (maps, graphs, statistical summaries, etc.)

The ability to classify data in concrete and meaningful categories, e.g. classification of data obtained from surveys.

4. The ability to study the landscape at first or second hand, and to identify a variety of concrete elements, for example rocks, soils, vegetation, streams, waterfalls, hills, mountains, valleys, plains, deserts, coasts, reefs, forests, cliffs, swamps, landslides, clouds; buildings, houses, shops, factories (multi or single storey, local or regional centres); ports and airports; roads and vehicles; sea transport.

Affective objectives

1. An appreciation of the variety of environment on the earth's surface

2. An appreciation of the importance of the role of people as agents in changing the spatial systems through their actions and decisions

3. A willingness to pursue a line of enquiry in search of data and conclusions

4. A recognition of the need for a balanced use

of the earth's resources, which acknowledges that 'economic' man and 'conservation' man must both seek balance in solving problems; an attitude which causes the person to ask two questions, 'Are people able to do it?' and 'Should people do it or allow it?'

5. An ability and willingness to make value judgments, as witnessed by the student's approach to issues involving value decisions

6. A willingness to listen to and work with other people, other students and teachers — without query of religion, race, colour, etc.

7. A positive attitude to learning.

Psychomotor objectives

1. Map-making skills — ability to use the scale to measure distance and area; ability to give directions; ability to handle simple transects, and to understand and work with simple grid systems
2. Ability to sketch landscape — in the field and from secondary data, e.g. photographs
3. Ability to apply various mathematical and scientific skills, e.g. the drawing of graphs, the reading of weather instruments
4. Ability to carry out surveys within the local area.

In conclusion, a final point should be made. The specific studies in this book are not meant to be learnt by rote. Certainly the student will gain some specific knowledge, and indeed one of our objects was to select subject matter which is relevant. But we see no reason for the student to copy from, or to paraphrase, the material within the text, or to be asked in term tests, or end-of-year examinations, to recall the specific details of a particular study.

Teacher's Resource Kit

A resource kit is available for the assistance of teachers using Level One. The principal contents of the kit include:

1. Teacher's resource booklet — this contains a chart to show the objectives, recommended activities, materials and time allocation for each study
2. Set of 24 supporting slides with explanatory notes
3. Tape recording and accompanying notes for study 5 — A Dairy Farm
4. Set of 10 overhead projector transparencies with accompanying notes.

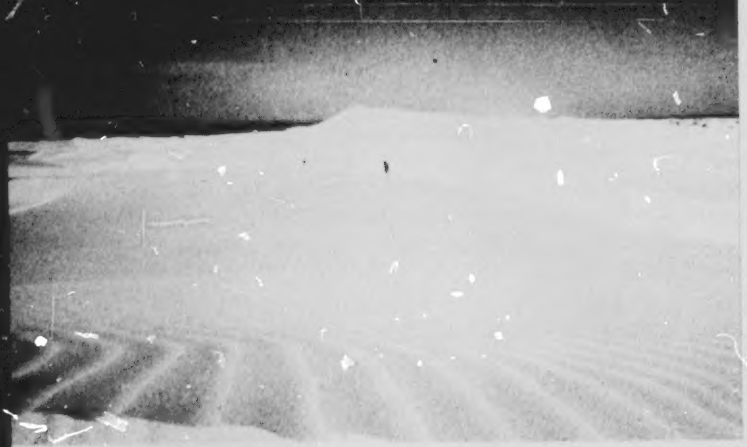


Figure 1.1: Sand dunes in Western Australia **(R. Harrison)**

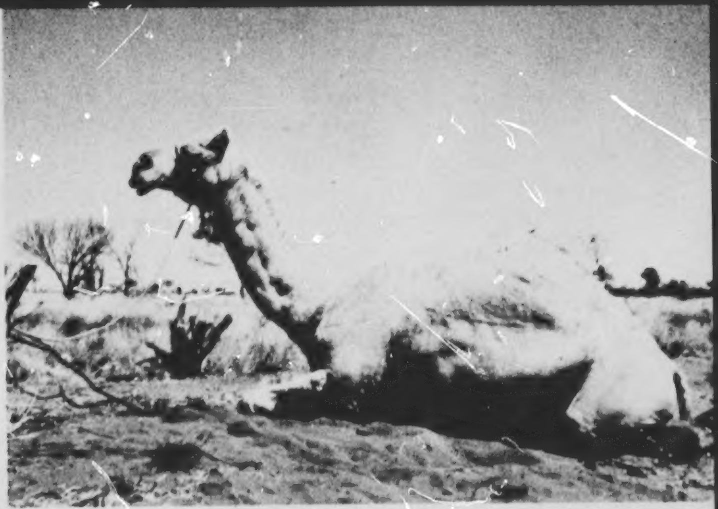


Figure 1.2: Desert life in South Australia **(R. Harrison)**

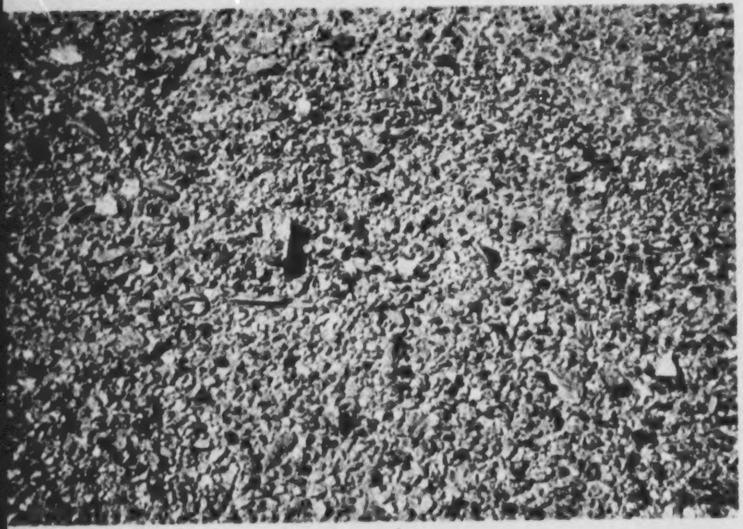


Figure 1.3: Stony desert: gibbers north of William Creek (towards Oodnadatta), S.A.

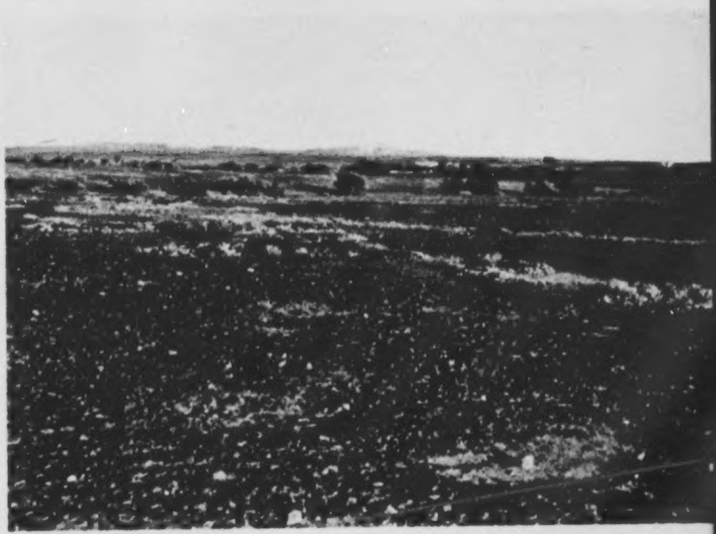
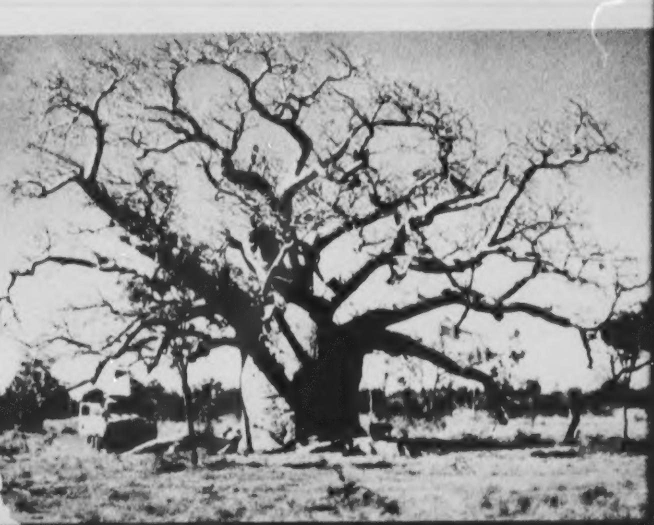


Figure 1.4: Stony desert before rain, 50 kilometres south of Oodnadatta, S.A.

Figure 1.5: Desert after rain, Broken Hill, N.S.W.

Figure 1.6: Baobab tree, W.A. **(R. Harrison)**



1

Grasshopper country: the desert fringe

When someone speaks of a desert, what picture comes to your mind? Do you see line on line of sand dunes, their tops blowing off in the wind? Do you see bare rocky plateaux and stony gullies? Do you see wide plains covered with thousands of flattish, irregular stones? Do you see dry lake beds covered with salt? All these features can be seen in desert areas, but most of them exist in other places too.

Do you think perhaps of a very hot place with the sun beating down from a cloudless sky? Such conditions are indeed found in deserts, but they are also found in cultivated parts of Australia during a summer heatwave.

Perhaps you think of a place where water is so scarce that everyone suffers from thirst — human beings, animals and plants. This is nearer to a true description of a desert: a place where shortage of water influences all other activities. Yet there are few deserts which have no rainfall at all, and some forms of plant and animal life can survive in all of them.

Study the figures in table 1·1 carefully. They show the actual rainfall recorded at Iron Knob in South Australia for every month in the 24 years from 1944 to 1967. The rain is measured in millimetres.

1. In which years were there two consecutive months with no rainfall at all? How might the ground surface look at the end of two such months? If you dig a hole about 30 cm deep, would the conditions at the bottom of the hole be any different? You could experiment with the soils in your area by digging holes in the dry and wet months.

2. In how many months during this period did

Table 1.1: Iron Knob — monthly rainfall in millimetres, 1944-67

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1944	0	64	0	31	26	0	8	7	10	4	2	36	188
1945	17	7	0	0	11	15	6	11	15	29	17	42	170
1946	35	186	4	7	0	3	17	7	9	4	52	32	356
1947	5	23	75	29	3	17	22	15	18	35	0	14	256
1948	0	0	0	14	5	12	4	9	0	31	8	28	111
1949	0	32	0	3	46	10	25	2	30	26	13	11	198
1950	0	66	4	12	61	13	13	11	7	20	21	6	234
1951	0	2	16	0	4	48	22	15	10	24	0	9	150
1952	52	0	24	25	76	13	17	10	11	30	35	9	302
1953	19	54	0	2	2	24	7	18	25	15	13	37	216
1954	26	2	0	65	0	51	6	20	1	25	44	33	273
1955	0	17	43	11	35	26	11	30	27	14	17	2	233
1956	2	20	2	1	27	18	80	1	23	37	9	0	220
1957	0	4	2	3	1	11	13	14	13	12	2	7	82
1958	0	0	54	15	18	0	32	30	39	8	9	12	217
1959	10	17	21	0	6	4	27	3	2	9	14	7	120
1960	31	56	6	27	35	11	44	9	50	3	11	12	295
1961	13	12	9	86	5	3	14	18	12	0	55	4	231
1962	16	6	22	7	42	6	12	13	3	28	1	32	188
1963	14	8	19	97	56	46	32	33	2	5	5	2	319
1964	4	4	4	29	5	12	18	12	53	18	3	6	168
1965	0	0	1	4	28	18	14	37	13	1	6	16	138
1966	10	21	25	0	28	34	16	10	19	10	19	86	278
1967	32	62	0	1	7	6	12	12	12	2	0	6	152

more than 50 mm of rain fall?

3. In how many months during this period did less than 5 mm of rain fall?

4. In what month and year was the rainfall greater than the total for all months of the previous year? What effects might be noticed on the surface at the end of this month? Figures 1·4 and 1·5, showing desert areas before and after rain, may be of assistance to you. Check the rainfall records for the place where you live to see whether the rainfall in one month has ever been greater than the total for any whole year.

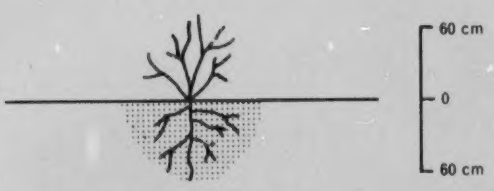
5. Look at the totals for Iron Knob for each year. The average annual rainfall is 212 mm. Do you know how the average is worked out? In what year was the actual rainfall more than 50 per cent below average? When was it more than 50 per cent above average?

6. Graph the monthly rainfall figures for Iron Knob for three years: the year of maximum rainfall, the year of minimum rainfall, and a year of average rainfall.

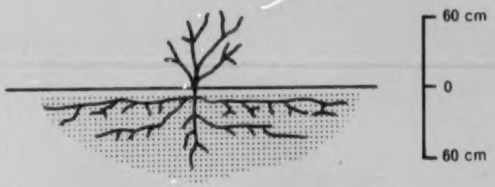
We see from these investigations that the rainfall at Iron Knob is not only light but also very unreliable. Any one month may have either no rain at all or a large quantity all at once. This unreliability makes life even more difficult than it would otherwise be in such areas. No plant can live without water, and animals depend on plants for food, either directly or indirectly by eating other animals which are herbivorous.

It is possible to measure how much water would evaporate from an unshaded water surface in each month. There are no lakes at Iron Knob, but an evaporometer, which is a large open dish of water about a metre across, with an accurate measuring device, would give results something like those in table 1·2. Compare these figures with those in table 1·1. For how many months in the 24 years covered by table 1·1 did rainfall exceed evaporation? What is the significance of this?

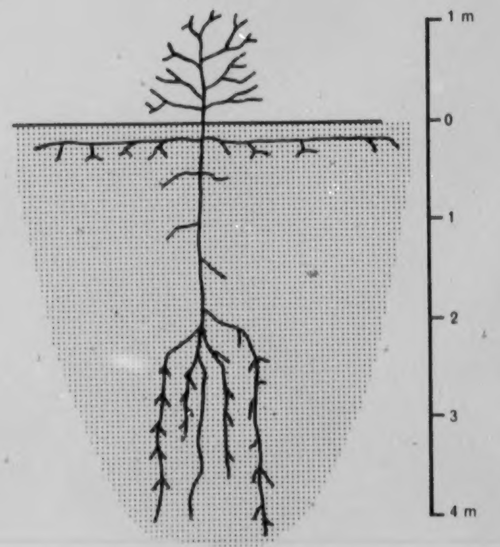
It is only when the soil is moist that seeds will germinate and plants will grow. After each rain in desert areas, growing conditions are favourable for a short period, and many species of plants germinate at such times; they grow fast, flower in a few weeks, and leave mature seed to lie on the ground until conditions once more become favourable. Plants like this, with a short life cycle,



Plant with adequate rainfall



Ephemeral desert plant



Perennial desert plant

Figure 1.7: Desert plants

Table 1.2: Iron Knob — monthly evaporation in millimetres

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
279	241	211	140	84	66	61	86	91	178	206	262	1,905

are called *ephemerals*. In order to use all the available water, their root systems spread over a wider area than that covered by the bush above ground (figure 1·7). In this way the bare patches which often show between desert plants may in fact be occupied below the surface by a network of roots (figure 1·8).

There is another group of desert plants which have a longer life cycle and do in fact live through the dry periods. They send down very long tap roots which are able to find water remaining deep in the earth long after surface supplies have evaporated (figure 1·7). These plants are called *perennials*, and include the desert trees as well as some kinds of bushes. Many of them have tough outer surfaces which reduce loss of water by evaporation. Others have juicy leaves or stems which store reserves of water. Can you name some of these plants? Two of them are shown in figures 1·6 and 1·9.

A few weeks after rain, the desert may be so well covered with vegetation that it resembles pasture land in better watered areas, yet a month or two later only the perennials survive and the dead remains of the ephemeral plants blow away in the wind, leaving seeds to wait for the next rain.

From this study you should gain some appreciation of the importance of *change over time* in the desert landscape. This is an important idea which you will find appearing in the other levels in this series.

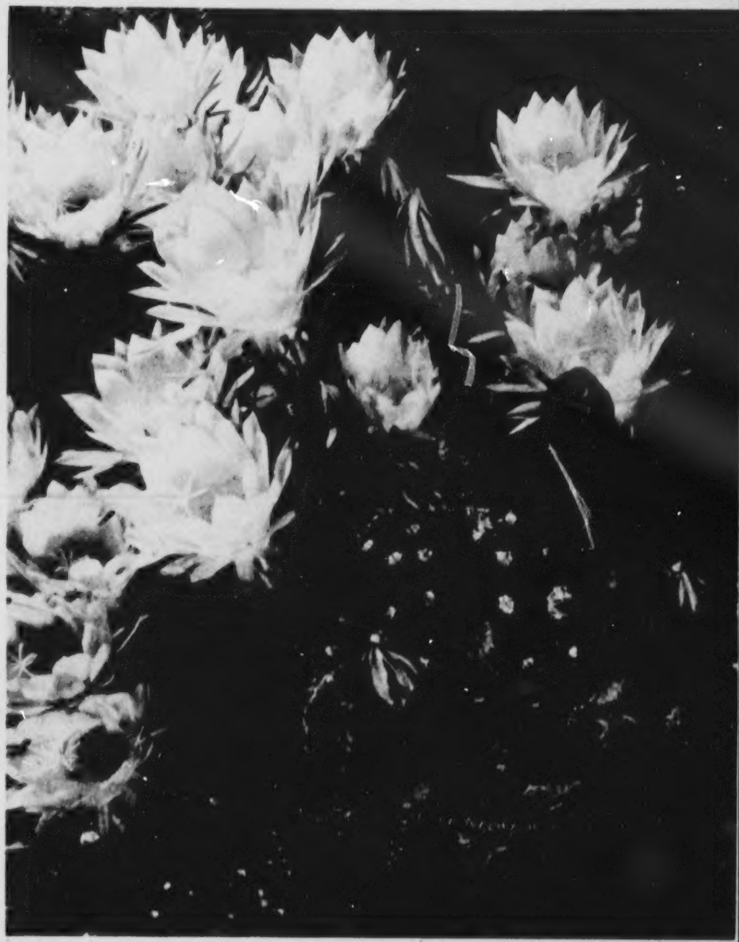


Figure 1.9: Flowering cactus ***(SATOUR)***

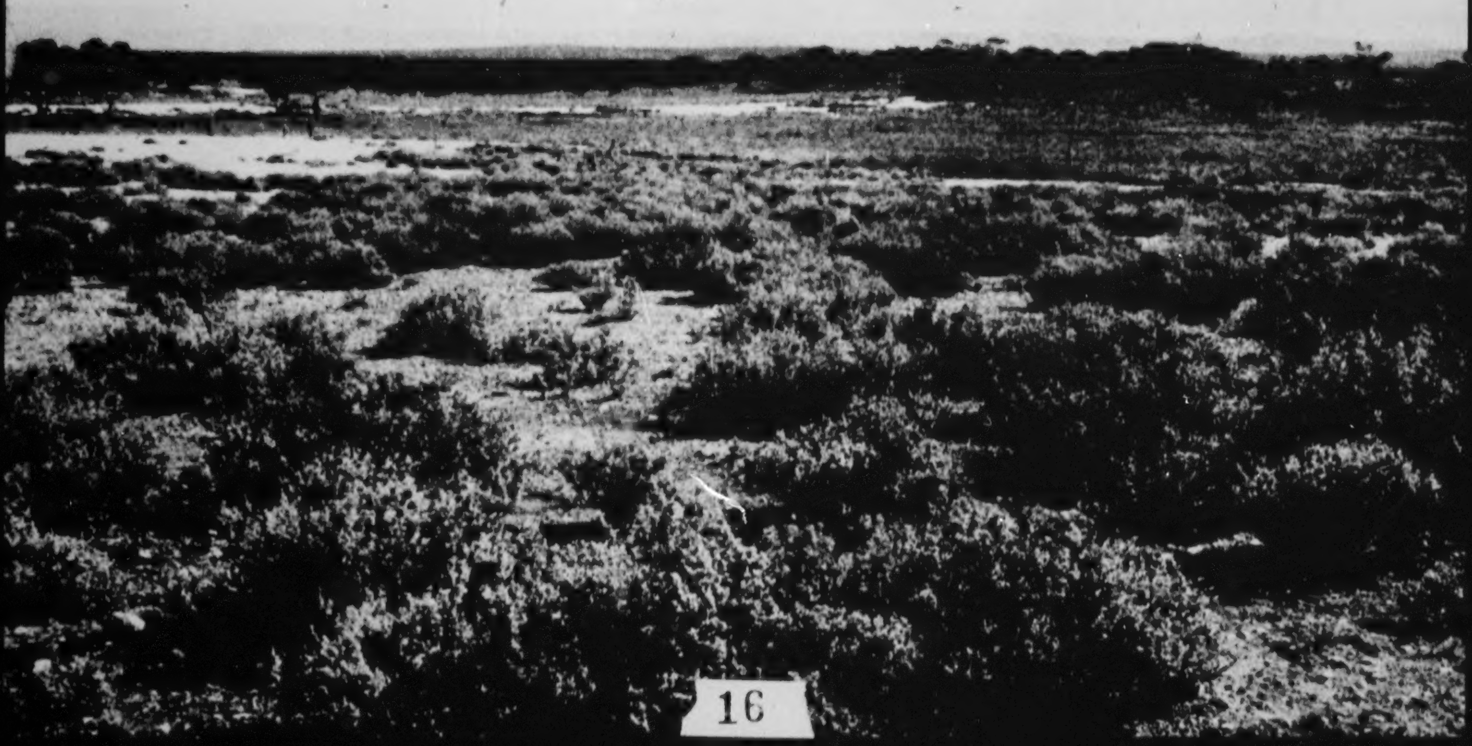


Figure 1.8: Growth mode of ephemeral desert plants ***(Dept of Agriculture, South Australia)***

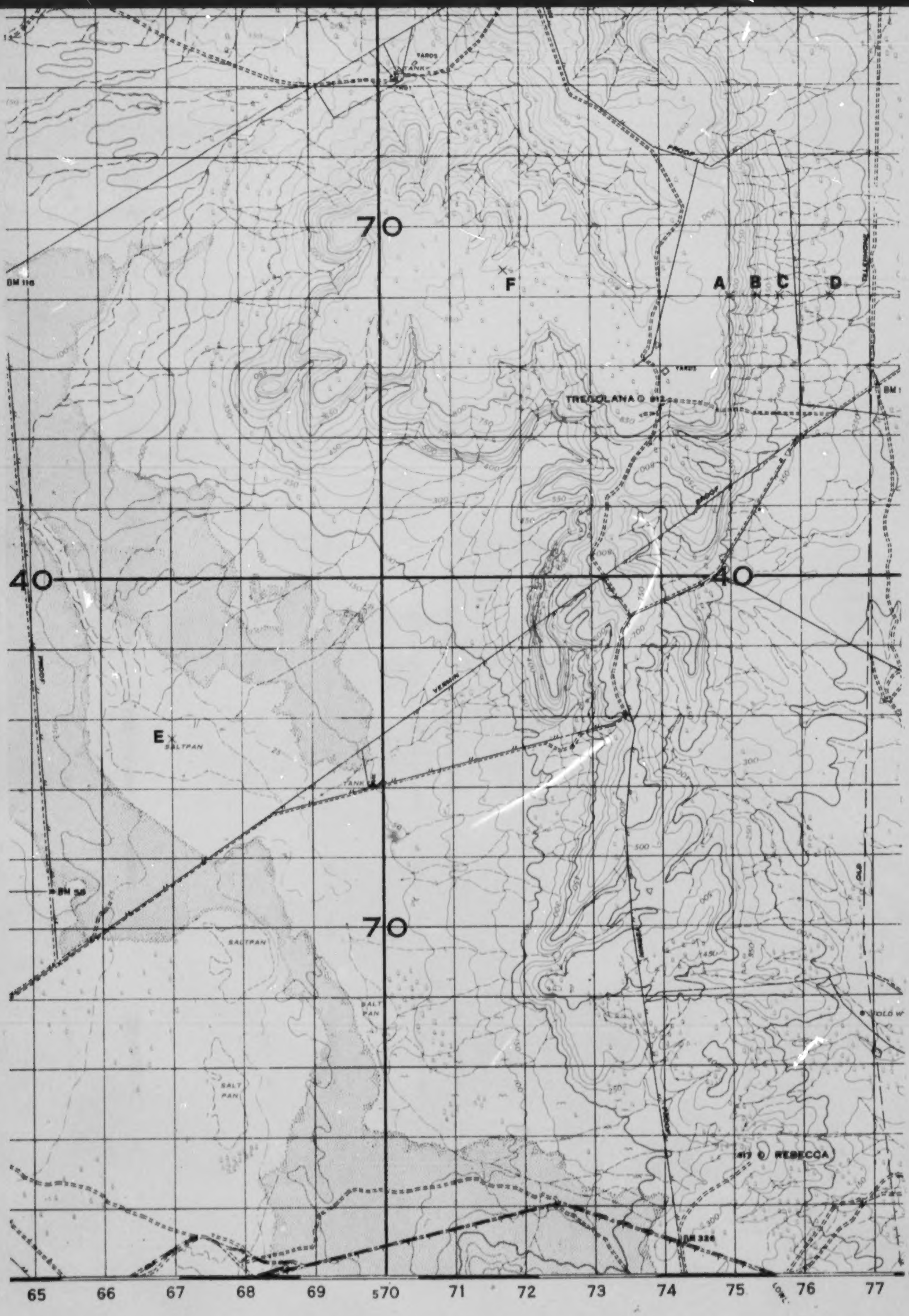

YARDS
TANK
70
BM 116
F
A
B
C
D
YARDS
TREGOLANA
40
40
VERMIN
PROOF
E
SALTPAN
TANK
BM 56
70
SALTPAN
SALT PAN
SALT PAN
REBECCA
BM 326
65
66
67
68
69
570
71
72
73
74
75
76
77

Figure 1.10: Extract from topographic map sheet — Lincoln Gap (Special), S.A., 1:63,360, second edition 1955. Contour interval 50 feet. See page 156 for map legend. ***(Directorate of Military Survey, Canberra)***

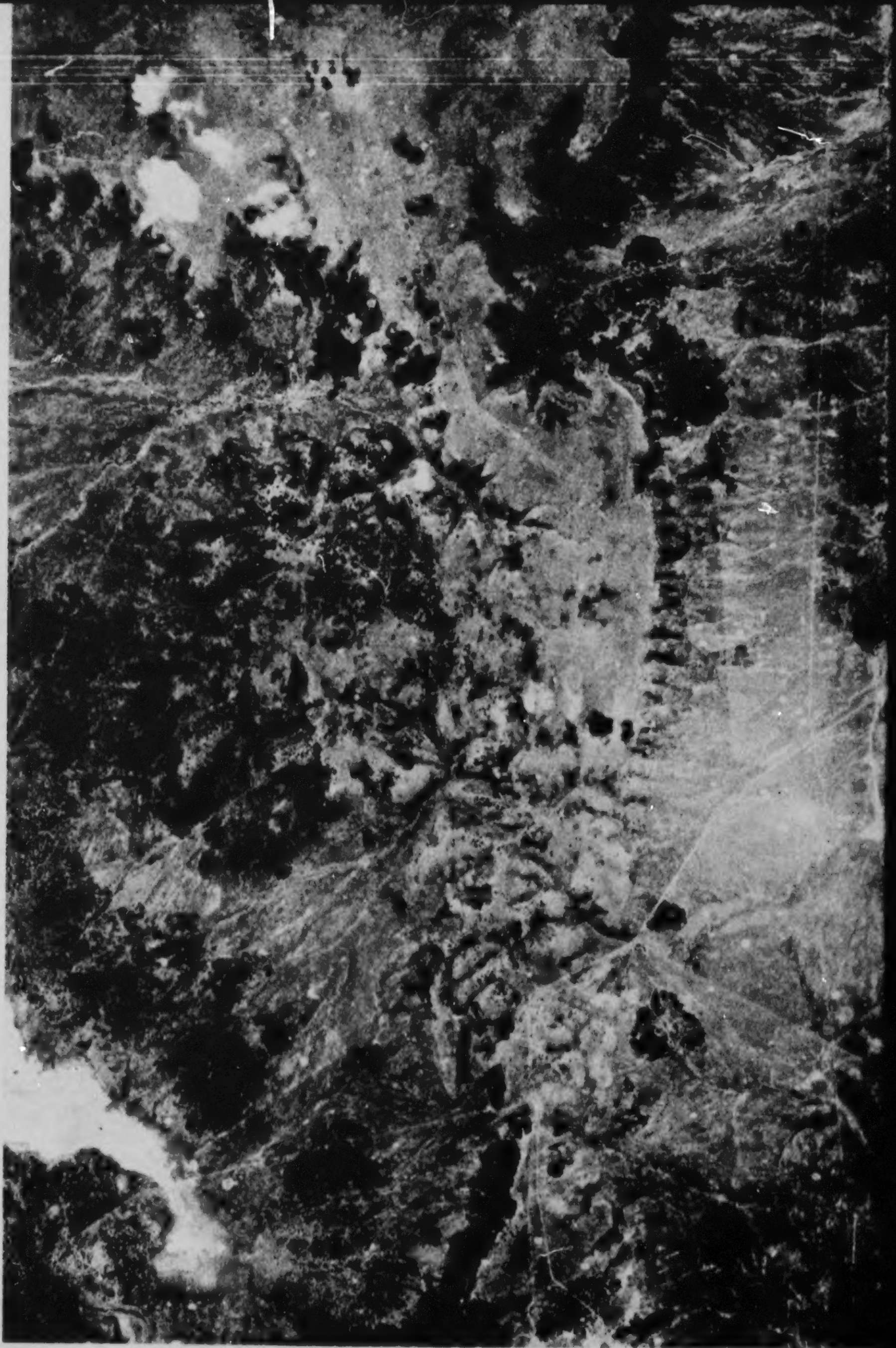
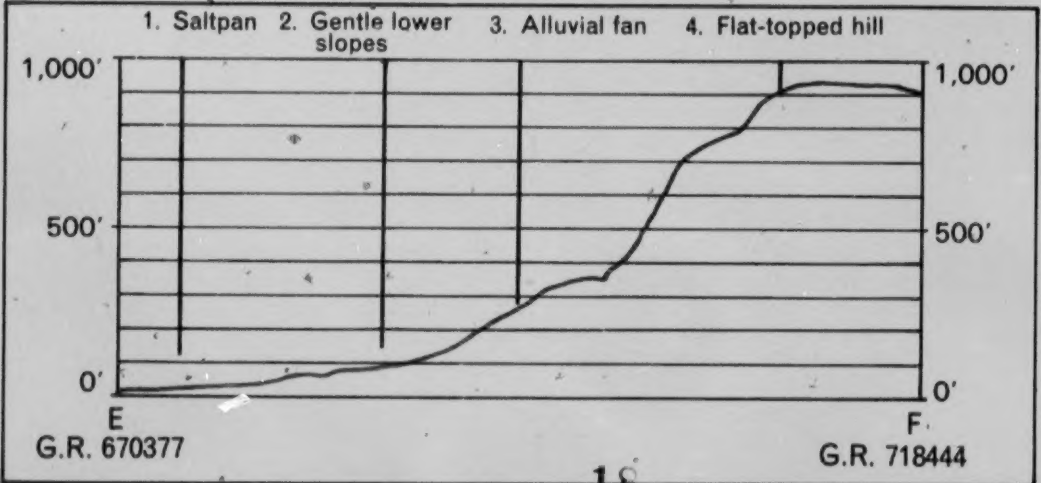


Figure 1.11: Vertical aerial photograph of area shown in figure 1.10 (1946)

Figure 1.12: Section across scarp



The area shown in the aerial photograph (figure 1·11) and the topographic map extract (figure 1·10) is approximately 50 kilometres east of Iron Knob. Refer to figure 1·10.

1. Can you see any advantages in using scales of 1:25,000, 1:50,000 and 1:100,000 rather than scales of 1:31,680, 1:63,360 and 1:126,720?
2. How many inches to the mile is represented by the scale 1:63,360?
3. How would the map change if the scale was altered to 1:126,720?
4. How would the map change if the scale was altered to 1:31,680?
5. Which slope is steeper, A-B or C-D? To work this out, find the difference in height between A and B in feet, and how far apart they are in yards. Do the same for C and D. Converting the yard measurement to feet, express each as a gradient (*x* feet up for *y* feet horizontally). A gradient of 1 in 10 is quite steep for a car: could you drive a car up these slopes? (The positions shown on the map are best described by using grid references. For example, the grid reference for A is 750440; what is the reference for B?) How would you have calculated the gradient if the units used on the map had been metric ones?
6. Find these same slopes in the aerial photograph. In southern Australia the sun, even at midday, is not directly overhead but in the northern sky. Note the shadows on the northern sides of the valleys in this scarp. By finding a valley running north and south elsewhere in the photograph, can you tell whether the photograph was taken in the morning or the afternoon?
7. Figure 1·12 is a rough cross-section from E (670377) north-east to F (718444). Consult a book describing landforms or an encyclopedia and find out how alluvial fans and saltpans are formed.
8. Describe the vegetation in the areas marked 2, 3 and 4 on the cross-section. Check your answer against the aerial photograph. Suggest why there is no vegetation on the slopes between 3 and 4, and in the area 1. Only perennial vegetation is shown on the map. Where would you expect to find ephemeral vegetation after rain?
9. The streams on the map are described as intermittent. What does this term mean? Describe what you might have seen in the upper valley of such a stream, and in the saltpan, at the end of February 1946 and at the end of February 1958. Describe the vegetation which might have been seen on the gentle lower slopes in September 1963.
10. What signs are there on the map or photograph that this piece of country has undergone some human occupation?

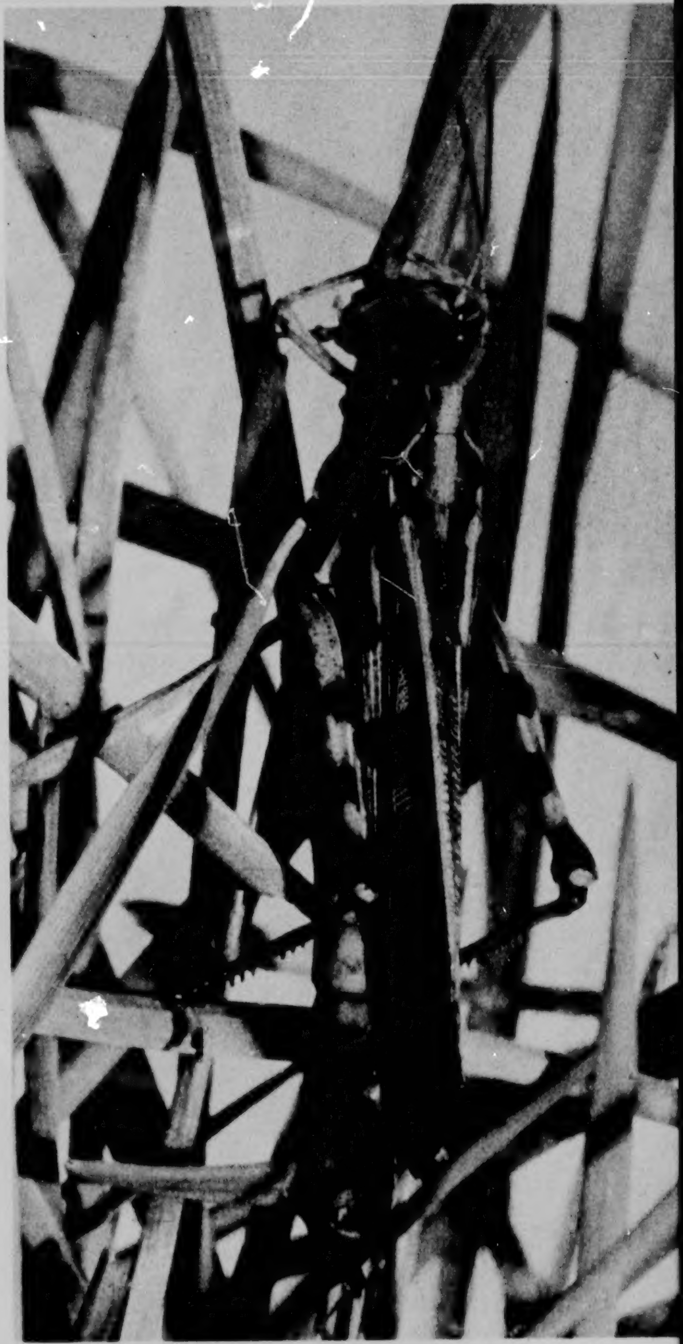


Figure 1.13: Mature locust eating grass (life size). Note the methods of eating and holding on to the grass, and also the camouflage for surrounding grass and shadow. ***(Brian Palk and Waite Research Institute, Adelaide)***

Locust movement

Ephemeral plants produce abundant food for insects for a short period, enabling large numbers to develop. When these plants die, however, there are only the perennial plants remaining with their small quantities of green feed. A few of the insects will survive on this food; the remainder will die with the return of dry weather, unless they have wings and can move to a more favourable area.

A good example of the way living creatures are related to the physical conditions of the place they inhabit is provided by the Australian plague locust, whose scientific name is *Chortoicetes terminifera.*

When the female locust lays her eggs, she bores a hole in a firm patch of soil, digging with the hard tip of her abdomen. While the eggs are being laid, they are mixed with frothy material which cements the walls of the hole, and the top centimetre of the hole is filled with dried froth only, allowing the hoppers to escape easily when they hatch. The eggs begin to develop when the weather is warm and wet, usually from September to April, and development stops if the eggs become dry or cold.

The young insect, after coming out of the egg shell, squirms to the surface where it sheds its skin and begins its separate existence. It is white at first, but in about an hour turns dark-coloured. This process of shedding a skin occurs five times as the hopper goes through stages of its development. During the process it hangs by its hind legs in the shelter of a tuft of grass, the skin splits along the back, and the insect squirms out, leaving the transparent skin hanging. After the fifth of these changes, the locust has fully-developed wings. See figures 1·13 and 1·14.

During the hopper stages, the insects need food and shelter, and both are provided by tussocky grasses. The compact soil needed for the egg-holes does not usually grow these grasses, while the soils where the grasses grow well are not suited for egg-holes. Therefore, the best hatching places are near the boundaries between the two soil types. See figure 1·15. It so happens that in north-western New South Wales there is a large area of country which is covered with little patches of both soil types, and this provides an excellent breeding ground for the locusts. This is also an area which, though nearly desert, gets spring and summer rain fairly frequently, and this kind of weather also favours hatching. See figure 1·16. Such an area in particular seasons can develop a large locust population, which, if local conditions then become dry, will migrate to other places where green food is available — usually the farming districts nearer the coast.

Figure 1.14: Locusts of two different stages (life size). The six on the upper part of the branch are at the grasshopper stage, where they cannot move very far. The larger one on the side of the branch is mature: because it has wings, it can move much greater distances. It is at this stage that large numbers can do great damage to vegetation. ***(Brian Palk and Waite Research Institute, Adelaide)***

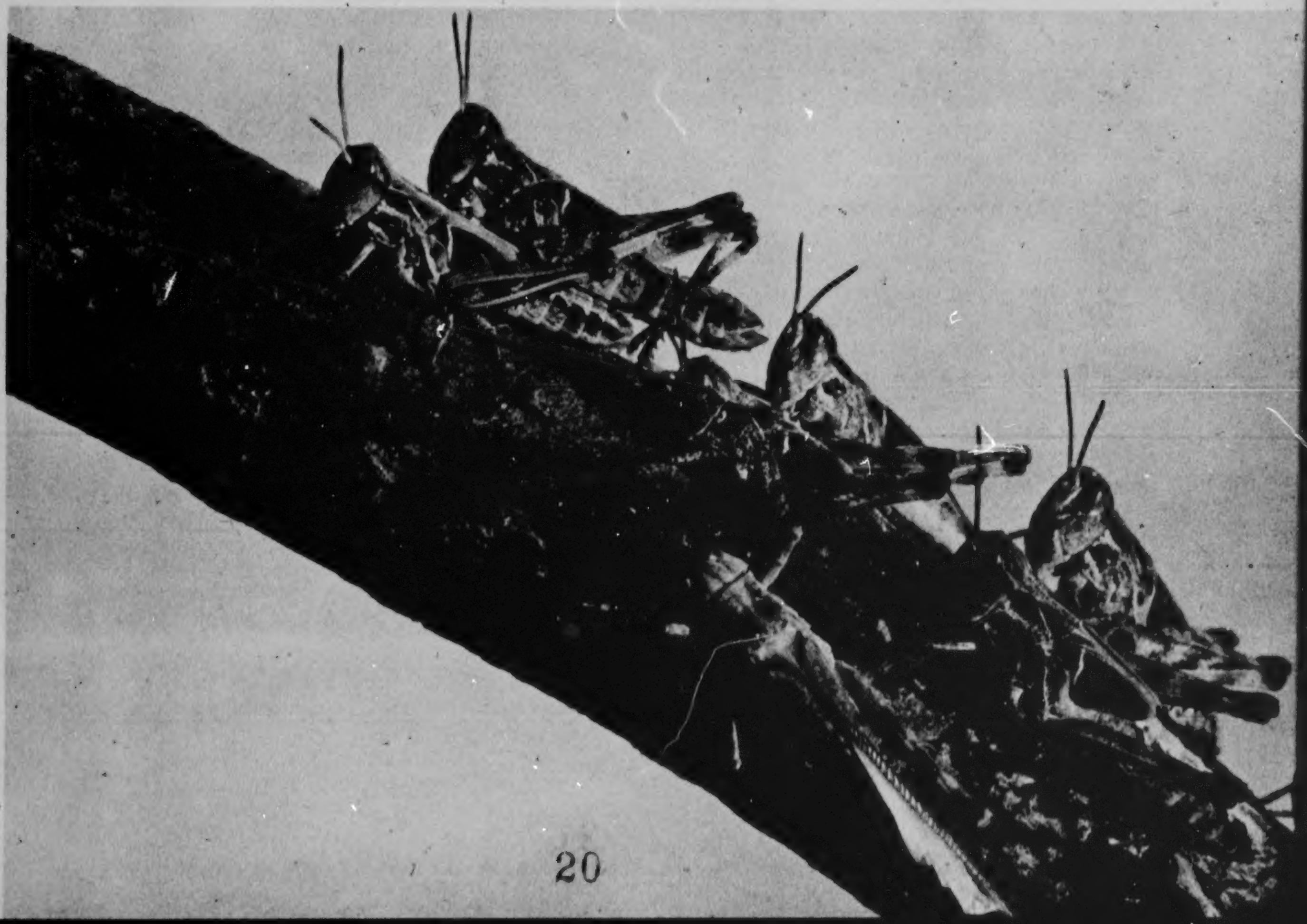
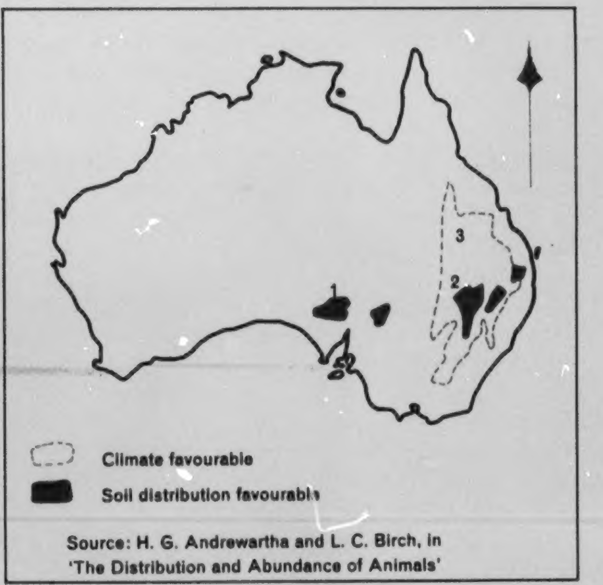


Figure 1.15: Country which favours locust breeding (Dr K. L. H. Key, CSIRO, Canberra)



Source: H. G. Andrewartha and L. C. Birch, in 'The Distribution and Abundance of Animals'

Figure 1.16: Locust breeding areas. Would you expect plague locusts to breed more readily in area 2 or in area 3? Why? Would they be more likely to breed in area 1 than in area 2? Why?

For those that stay in the breeding area, there are relatively few places where green grasses survive; the remaining locusts all move to these feeding areas and become an easy prey for birds, which reduce their numbers still further.

We notice that warm moist weather not only enables locust eggs to hatch, but also starts the growth of the ephemeral vegetation which the young hoppers will need for food; such links become increasingly apparent as we study the environment about us. Often when people add a new factor to the pattern, unexpected results appear. For example, if an area of desert vegetation is heavily stocked with sheep, more bare patches appear, which provide more suitable places for locusts to lay eggs. When the locusts hatch they compete with the sheep for food, and the edible pasture may be destroyed.

Try to collect other examples of the effect of animals and plants on each other and of the effect of animals on each other. What effect have people had on these patterns of interaction? You might start by looking for information in your school library on such topics as the following:

- The story of *Cactoblastis* and prickly pear in Queensland
- The effects of the crown-of-thorns starfish on the Great Barrier Reef (see study 2)
- Changes in the insect population when pastures are top-dressed with fertilisers.

FURTHER ACTIVITIES

1. Locusts move across the countryside in search of suitable food. What problems would a country face if people were capable of moving anywhere without any of the normal restrictions of society?

2. Conduct a survey of the movement of people within your school. This can best be done by

- Selecting a number of survey points and recording (at various selected times of day) the Form and sex of all students passing each point and their direction of travel (together with the times of any travel problems, e.g. severe blockages)
- Mapping and graphing the data obtained, using a base map of the school and grounds at a scale of approximately 1 centimetre to 5 metres for the purpose
- Describing the resultant patterns; you should carry out your survey on each day of the week, preferably surveying a wet and a dry day in each case
- Now, having studied the results of your survey, prepare a series of group reports on the most appropriate rules to control the movement of students in your school.

3. Discuss the value of the various forms of traffic control that are to be found outside the schoolground. Can you think of better ways of controlling traffic?

2

The Barrier Reef

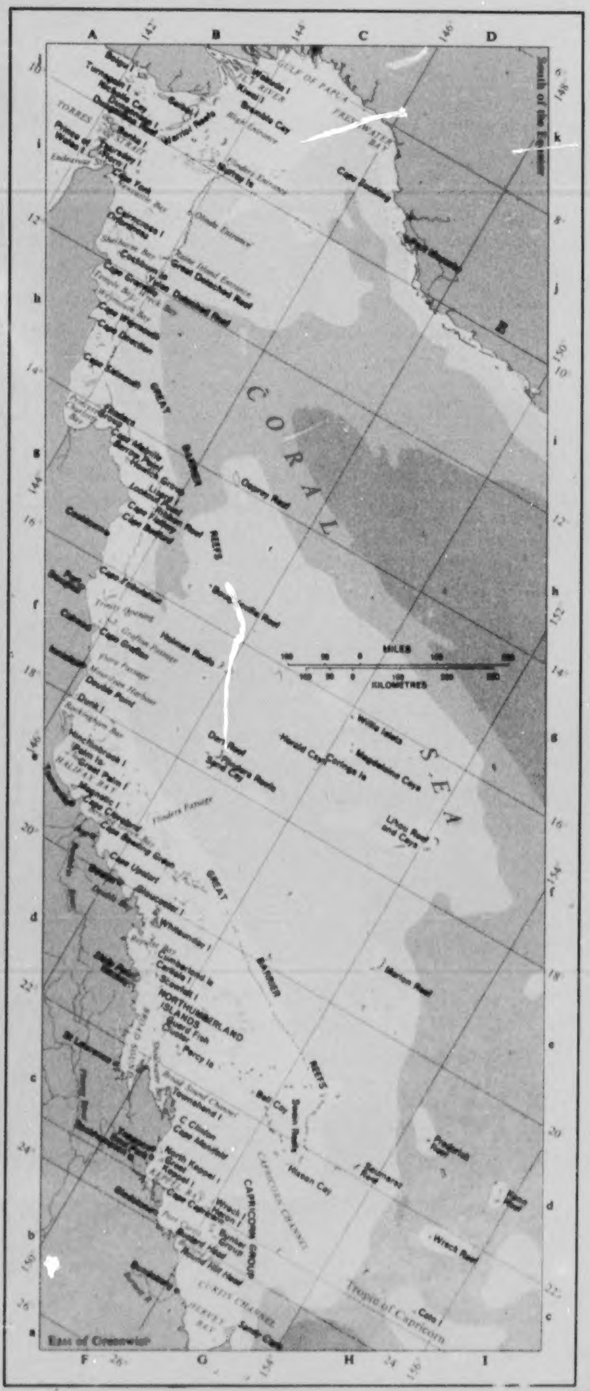


Figure 2.1: The Great Barrier Reef

The Great Barrier Reef, off the north-east coast of Australia, is the largest marine reef in the world. Refer to figure 2·1.

Is it correct to speak of *one* reef?

Over what distance does the Great Barrier Reef extend?

How far is it from the coast to the reefs?

How far out to sea do the reefs extend?

How could you best describe the location of the Great Barrier Reef?

In this study we will be investigating these questions:

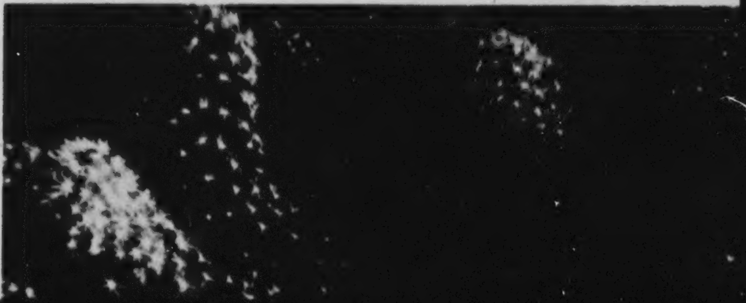
- Why does the reef exist where it does?
- Why does the reef continue to exist?
- In what ways is the Great Barrier Reef valuable?

Why does the reef exist where it does?

Despite the great size of the reef, it is due, in large measure, to the work of an animal which is usually about 6 millimetres or less in length. This animal is the coral polyp. The polyp is a delicate creature, and to protect itself it secretes a limy skeleton, just as a snail secretes a shell. The polyp sits in the resultant cup-like structure. (See figures 2·2-2·4.)

Figure 2.2: Coral with large polyps (here exposed)

Figure 2.3: Another coral with the polyps exposed



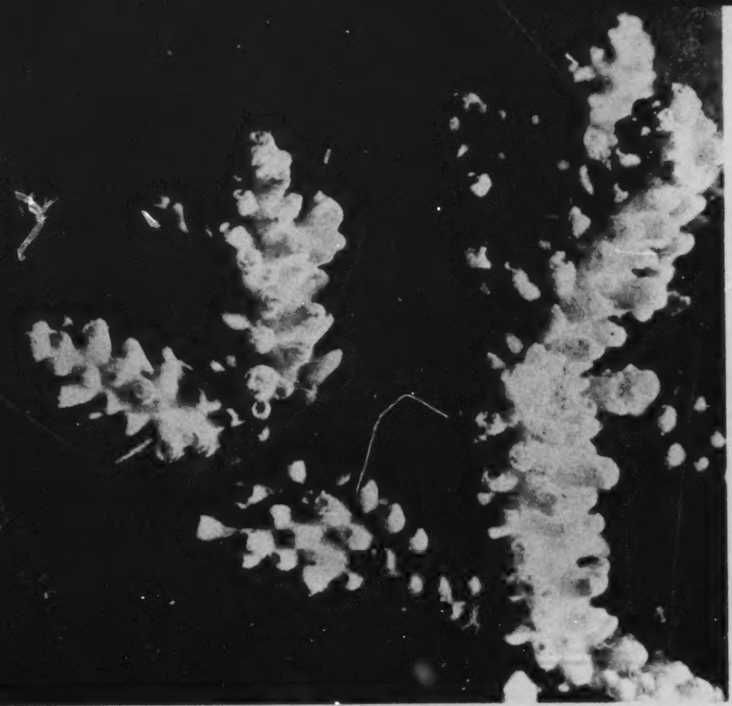


Figure 2.4: Calcium structure of coral with polyps removed (these holes are 3 millimetres in diameter)

At night, tiny organisms called plankton float towards the water surface. The polyp then expands and partially emerges from its shell to feed on the plankton (see figures 2·2 and 2·3). As plankton drift towards the polyp, the animal shoots out tentacles which cling to the prey and paralyse it. The plankton is then swept into the polyp's mouth. When the polyp dies, its hard skeleton remains as coral and forms the base for other polyps to attach themselves and grow. Cementing algae are almost as important in building up a reef, for they bind together the coral. The reef is further built up by molluscs, and by waves which pile up sands on the reef and consolidate them. Over many hundreds of years, huge reefs may be formed in this way.

Figures 2·5 and 2·6 show different types of reef, and two methods of reef formation. Bores drilled in the Great Barrier Reef have found reef materials at depths as great as 422 metres (Wreck Island, 1959, during oil exploratory investigations). However, the coral polyp rarely occurs at depths greater than 55 metres. How can you account for the coral being found at such great depths? Draw an atoll as it would appear from the air.

The coral polyp is a delicate animal, and requires a specific set of conditions for its survival:

- Coral polyps are found only in seas with a water temperature above 20°C. Fresh water has insufficient calcium for coral to form — the polyp extracts calcium carbonate from sea water to form the limestone of its skeleton.
- The polyps flourish only in water less than 25 metres deep. Deep water receives less sunlight, and sunlight is essential to the algae which live in the tissue of the polyp. These microscopic algae take over the waste carbon dioxide from the polyp, and with the aid of sunlight convert it back into plant food and oxygen. Thus the coral polyp has its wastes removed and fresh oxygen supplied.
- The polyp requires sea water that is free of sediment. Sediment reduces the amount of sunlight available to the algae living in the polyp, and it may also suffocate the polyp itself. What might be some factors that could increase the amount of sediment?

Living coral is mainly brown, but brilliant areas of red, blue, green and orange corals can be found in most reefs (see the photographs on pages 18-19). Why do you think the colours vary?

On the reefs, many fish species are not found in an area as close as 100 metres to an area in which they are abundant. Some reasons are variations in temperature range, wave action, depth of water, and the availability of food. During the day the reef plants provide oxygen, but at night this supply is no longer produced. Do you know why?

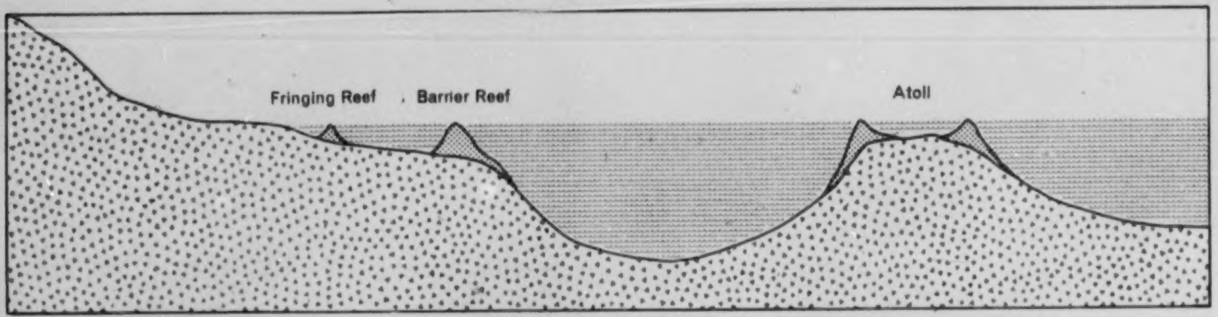


Figure 2.5: Types of reef

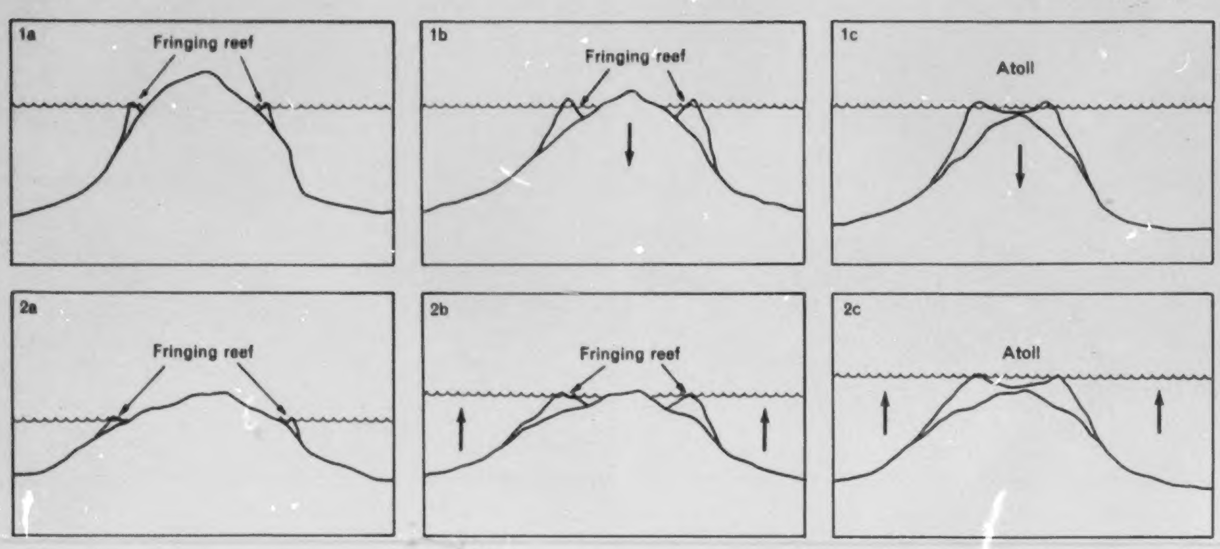


Figure 2.6: Reef-building

Some fish inhabit quieter waters because they are able to better stand the lower oxygen supply that is available there at night, compared with more open waters. Can you suggest why there is more oxygen in the open waters at night? The sharpness of the boundaries between different kinds of fish is quite amazing.

Refer to figures 2·7 and 2·8. How would you describe a mangrove swamp? How do you think the mangrove helps to build a reef or extend the area of land? Find a swamp in your area and map the location of the plants according to some classification of your own. Do the plants vary from the land to the water? Do they vary as the water becomes deeper? Can you explain any patterns you find?

Examine figure 2·9. This shows a fringing reef on a small island in the Barrier Reef. What reasons can you suggest for the shape in which this reef has formed?

Why does the reef continue to exist?

The reef is continually being built up and broken down. It is a hive of ceaseless activity, with all living things related to each other in some way. A simple method of showing the relationship is to think of some plants as *producers* of food from water, carbon dioxide, and the light and heat of the sun. The name for this process is photosynthesis. Other living things are *consumers* or feeders. They eat the producers or part of the producers. Eventually the consumers die and are

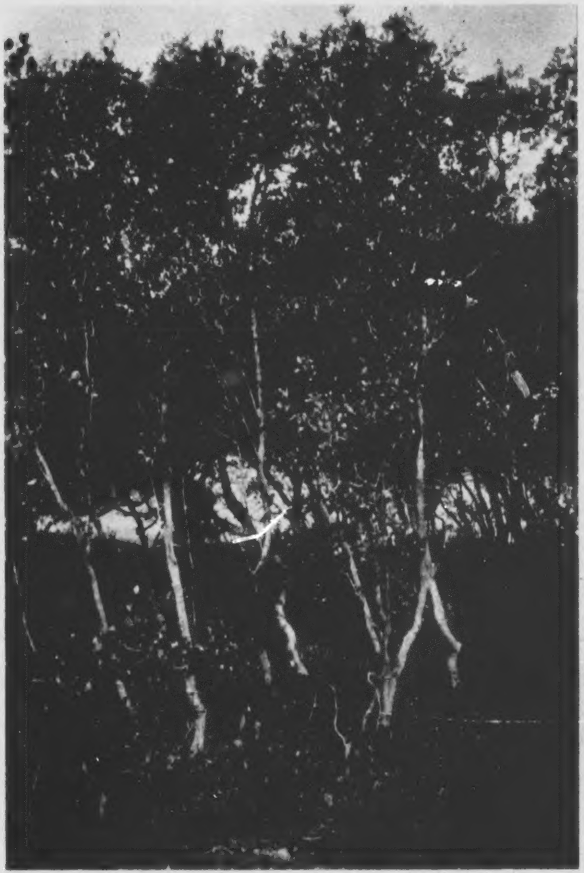


Figure 2.7: Mangrove trees, Lane Cove River, N.S.W.

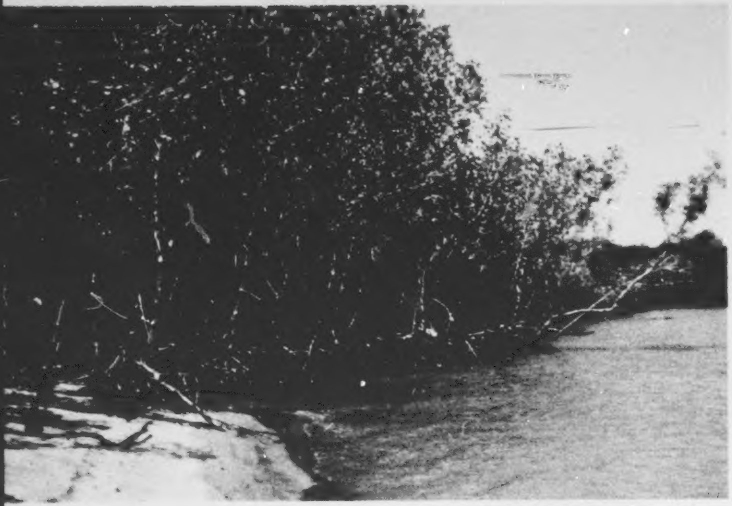


Figure 2.8: Mangroves at Townsville, Q. **(Dr D. H. Ashton)**

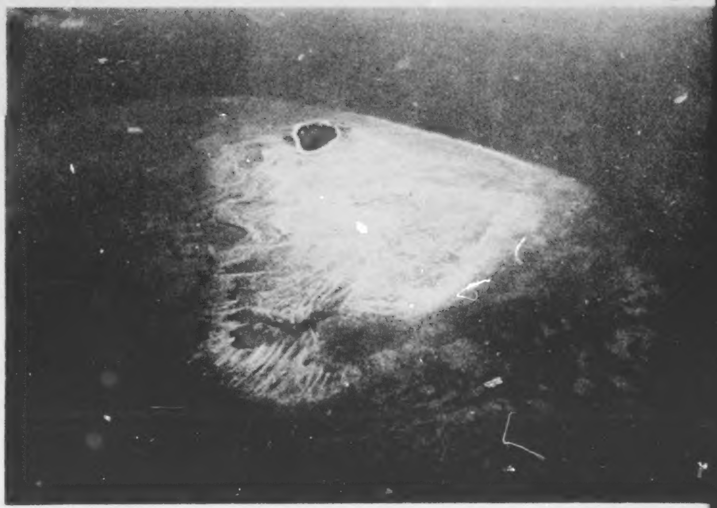


Figure 2.9

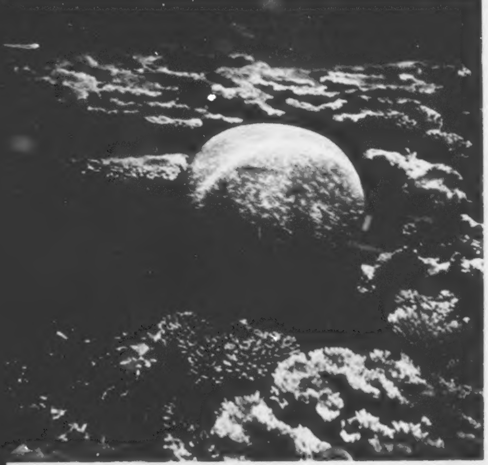


Figure 2.10: The edge of a reef

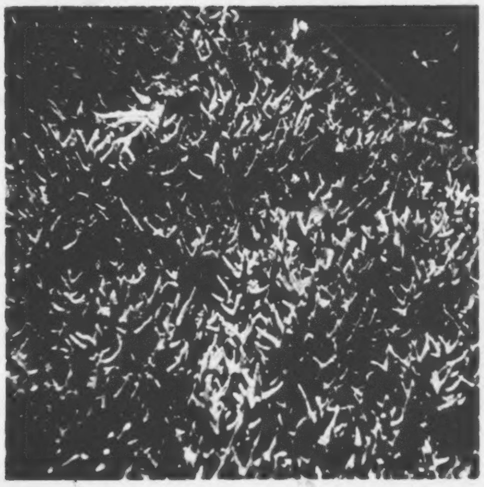


Figure 2.11: Staghorn coral

Figure 2.12: The reef at a depth of 20 metres

Figure 2.13: The base of the reef at a depth of 30 metres. The fish, a butterfly codfish, can inflict a powerful sting and lives on smaller fish

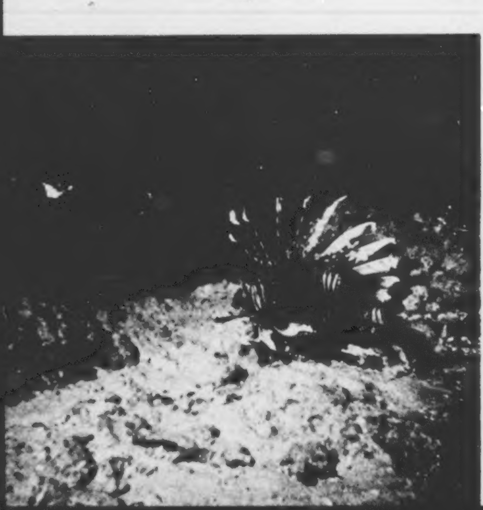


Figure 2.14: Large tabular forms of staghorn coral

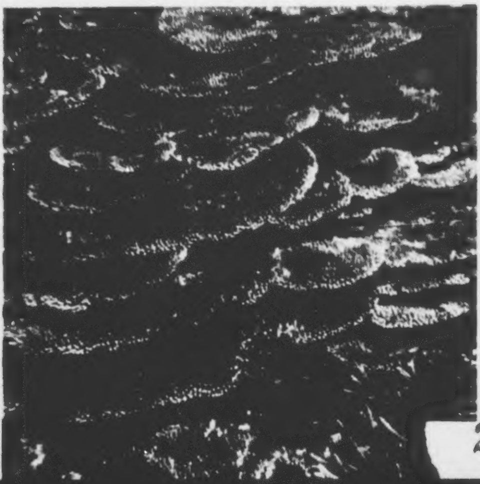
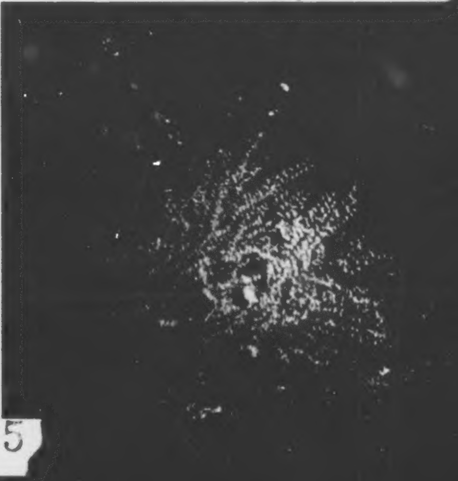


Figure 2.15: A coral found in ill-lit areas such as caves or deep water



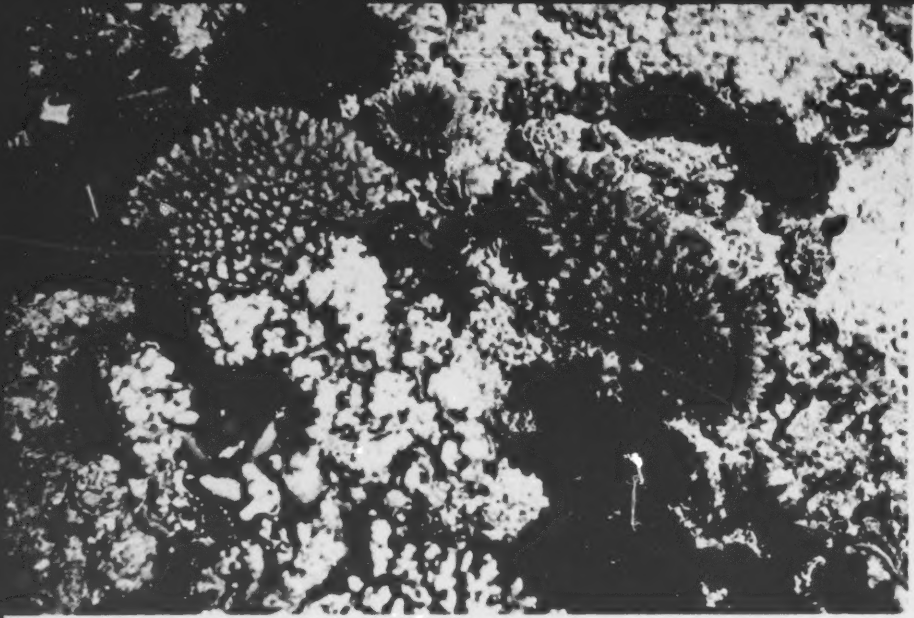


Figure 2.16: Corals in a sheltered pool, Heron Island

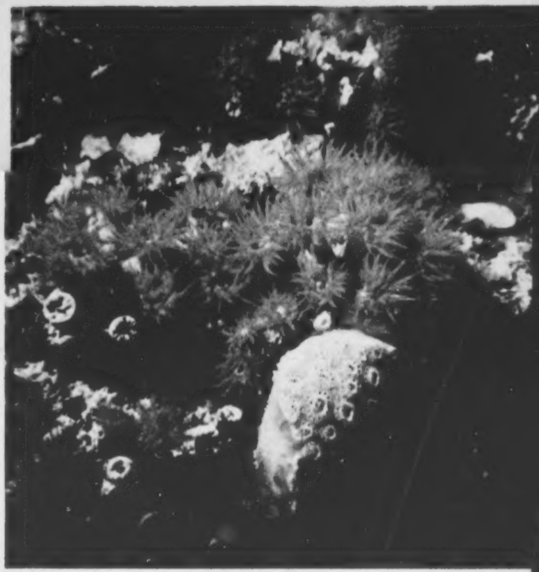


Figure 2.17: Sea anemones

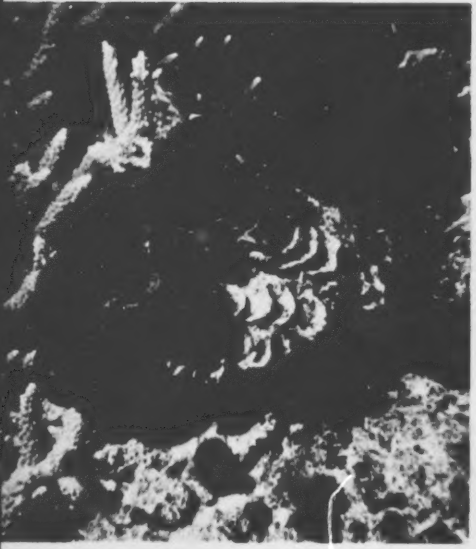


Figure 2.18: Clam—note the striking mantle

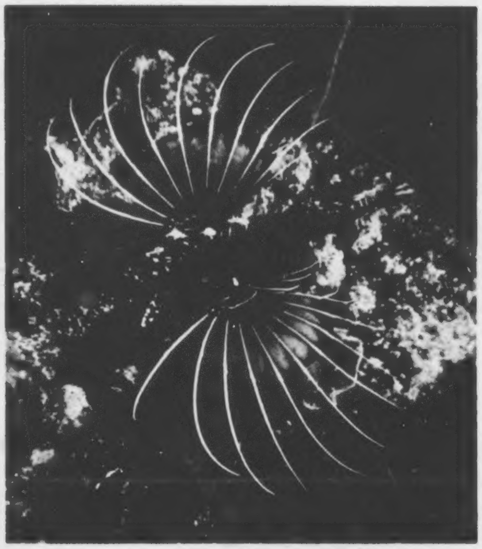


Figure 2.19: Butterfly codfish with fins extended in spectacular display

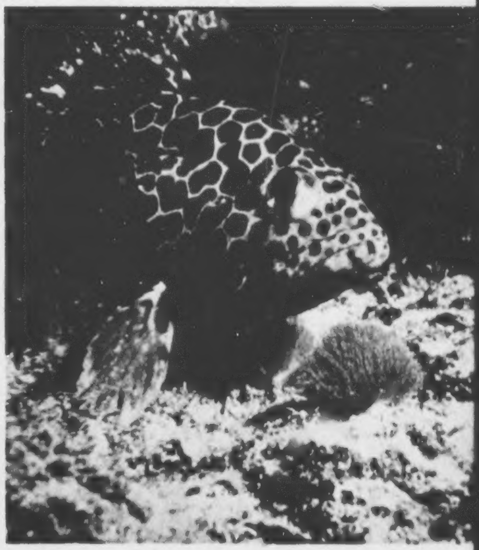


Figure 2.20: Honeycomb rock-cod

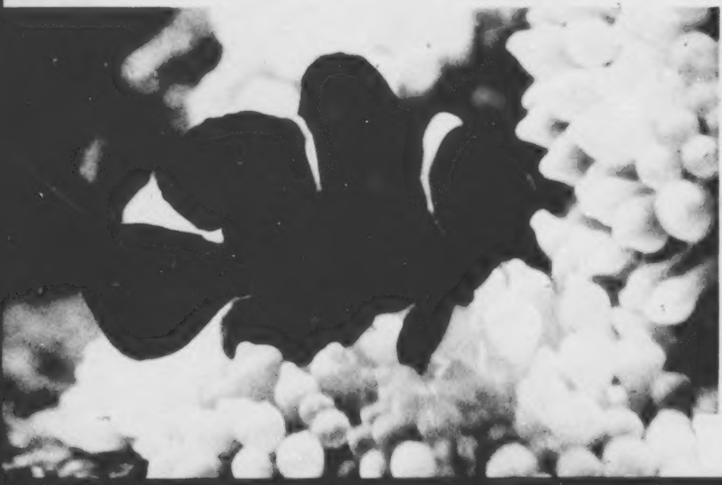


Figure 2.21: Clown fish

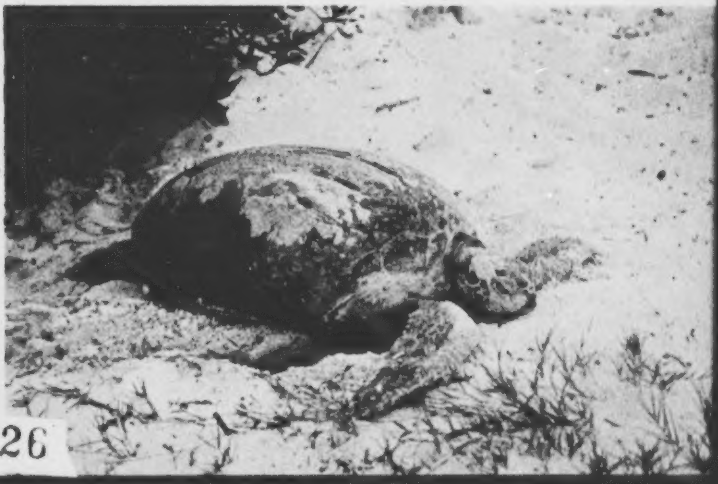


Figure 2.22: A turtle prepares to lay her eggs

then eaten by the *decomposers.* See figure 2·23.

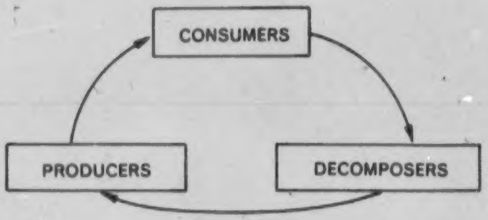


Figure 2.23

This process whereby one plant or animal gets food energy by consuming other plants or animals is called a *food chain.* For example, a grass may grow (producer) and be eaten by a caterpillar. The caterpillar is a consumer at the first level. Since the caterpillar eats vegetable matter, it is called a *herbivore*. The caterpillar may be eaten by a spider; the spider would be a consumer of flesh or a *carnivore*. Perhaps the spider may be eaten by a bird, and the bird by a cat. Bacteria and fungi (decomposers) may get food from any of the other levels of the food chain. The food chain could be set out as in figure 2·24.

Each level of the food chain has a definite relationship to the other levels. Each higher level has less food energy available to it because the lower levels consume some of the energy in their life processes and part of the material is not eaten and is left to the decomposers. Eventually all energy absorbed in photosynthesis is returned to the environment and radiated into space.

The whole system is in delicate balance; with the removal of any one of the factors or the introduction of a new one, parts of the existing system may be destroyed forever. The food chain for a coral reef is a rapid one (see figure 2·25). Can you find examples of the plants and animals of the food chain in the photographs illustrating this topic?

Refer to figure 2·26. Why does the system require so much producer material in relation to carnivore material? What is likely to happen if the producers are destroyed or made less productive?

The food chain diagram indicates that some animals feed exclusively on coral and that some coral food is included in the diet of other organisms. Certain varieties of fish eat the polyps from their skeleton cups, but perhaps the most famous of the coral destroyers is the crown-of-thorns starfish (figures 2·27 and 2·28). Coral can be damaged in many other ways:

- The cementing algae sometimes smother and kill living coral.
- During storms, waves can tear off great blocks of coral and smash them to rubble.
- Some living things burrow into the reef coral for food and so break it down to fine sand. These things include burrowing worms and burrowing molluscs.
- Cyclones often cause fresh water to flood over the reefs, and this too is a killer of coral. The polyps can only survive in water of high salinity.
- Very low tides, which occur from time to time, are also damaging. Exposure to sun and air kills the polyps.

The reef is thus the scene of a constant battle between the builders and the destroyers within nature itself. Once a reef is destroyed, it is very difficult for polyps to re-establish themselves. Claim jumpers, like the seaweeds, rapidly take over such areas. Can you think of any human situations in which similar issues occur?

A reef may also be damaged by people, perhaps in ways we do not yet know or understand. People can damage a reef directly, as when they trample over it, take coral away, or mine the reef. They can also damage the reef by upsetting the condi-

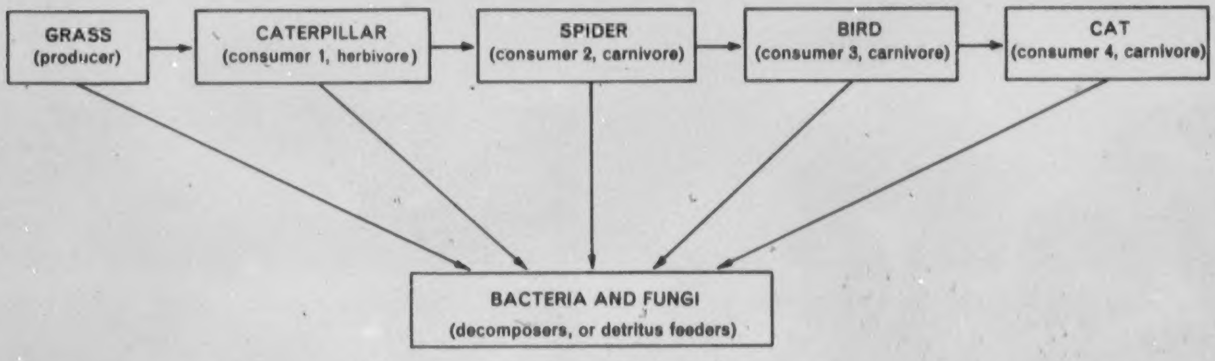
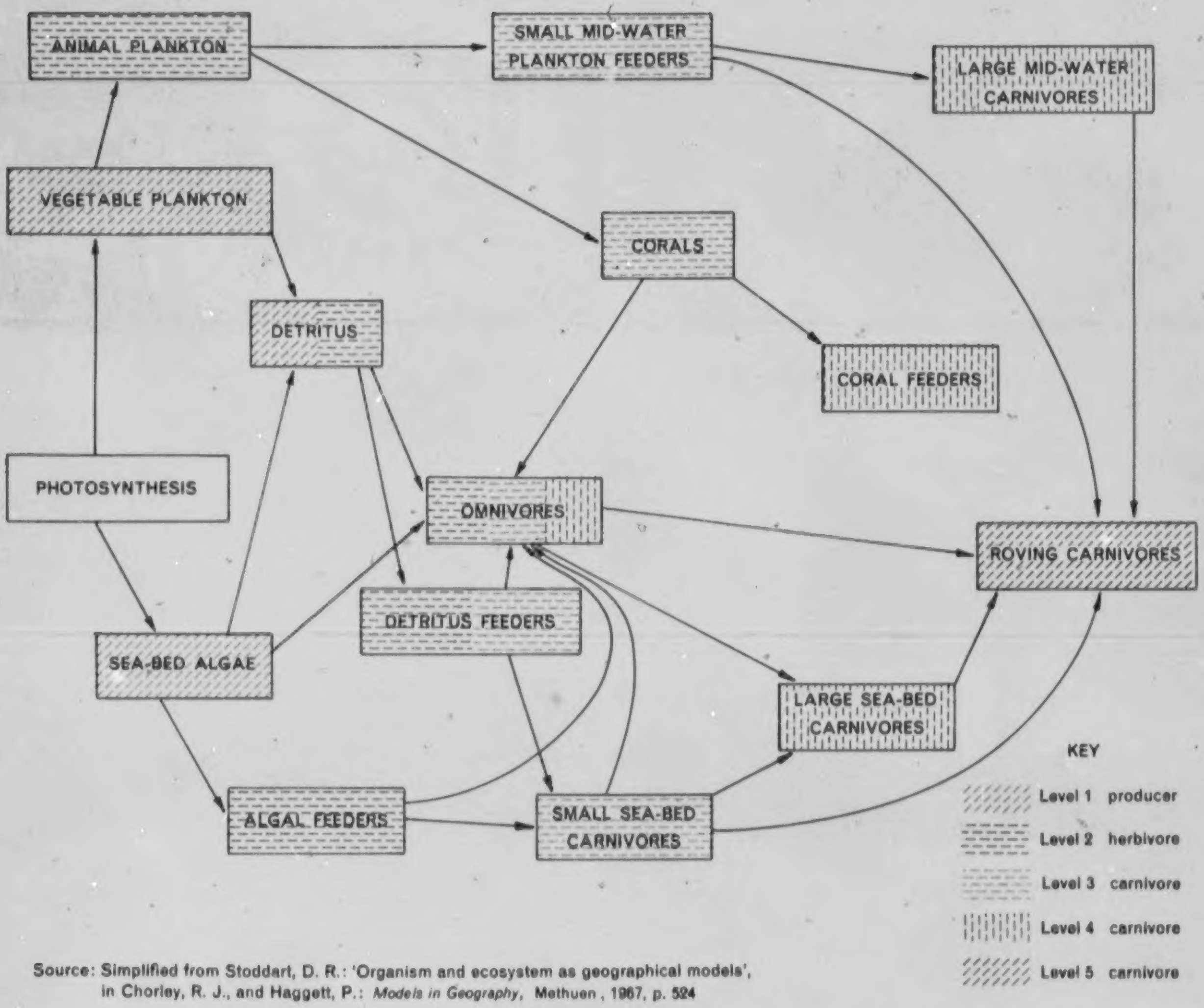


Figure 2.24: Food chain


ANIMAL PLANKTON
SMALL MID-WATER PLANKTON FEEDERS
LARGE MID-WATER CARNIVORES
VEGETABLE PLANKTON
CORALS
DETRITUS
CORAL FEEDERS
PHOTOSYNTHESIS
OMNIVORES
ROVING CARNIVORES
DETRITUS FEEDERS
SEA-BED ALGAE
LARGE SEA-BED CARNIVORES
ALGAL FEEDERS
SMALL SEA-BED CARNIVORES
KEY
Level 1 producer
Level 2 herbivore
Level 3 carnivore
Level 4 carnivore
Level 5 carnivore

Source: Simplified from Stoddart, D. R.: 'Organism and ecosystem as geographical models', in Chorley, R. J., and Haggett, P.: *Models in Geography*, Methuen, 1967, p. 524

Figure 2.25: Food chain for coral reefs in the Marshall Islands

tions that the coral polyps need for rapid growth. How do you think this could happen?

In what ways is the Great Barrier Reef valuable?

Tourism on the Great Barrier Reef is now a multi-million dollar industry—in 1970 more than 300,000 people visited the reef. Should the area be developed as a tourist attraction? If so, how should it be developed? Should the reef be a series of islands developed like a suburb?

Source: D. R. Stoddart, op. cit.

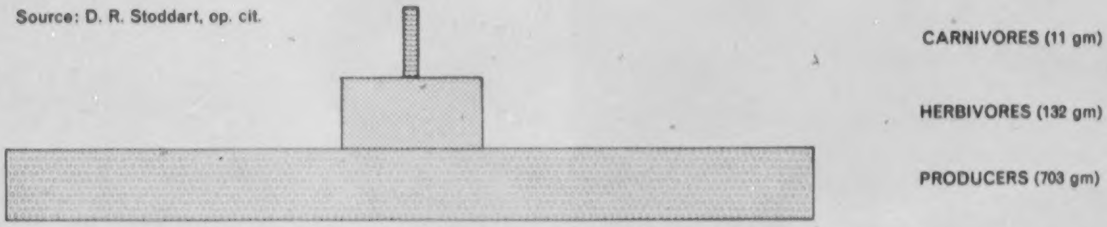


Figure 2.26: Average dry weight of living matter from sample square metre areas of the reef of Eniwetok atoll, Marshall Islands

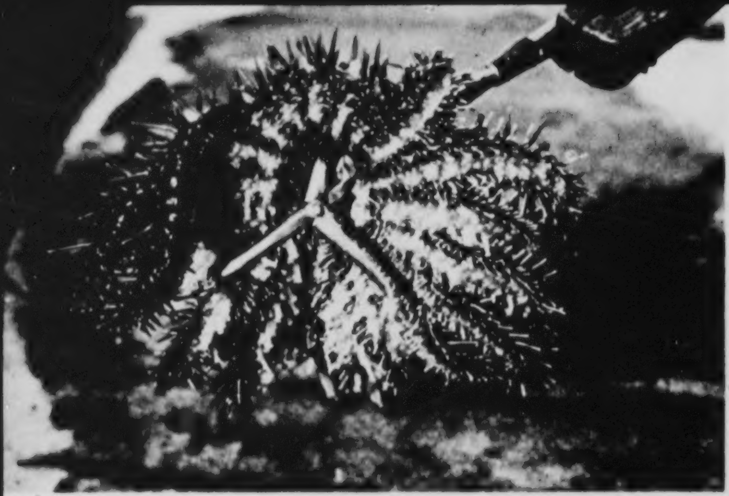


Figure 2.27: Crown-of-thorns starfish (Acanthaster planci)

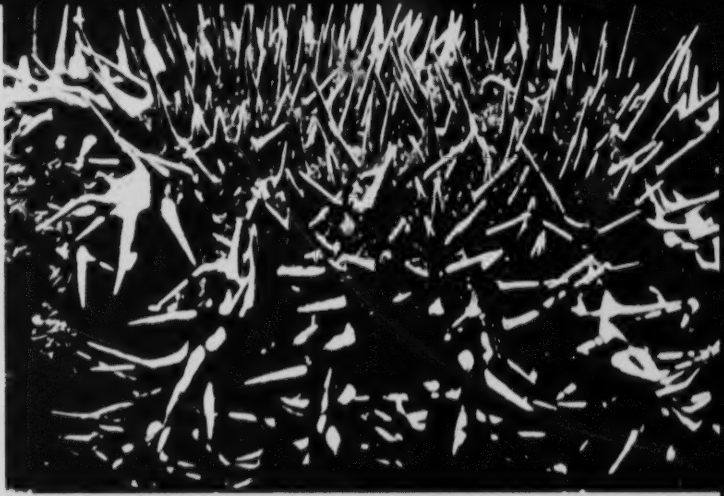


Figure 2.28: Close-up of crown-of-thorns showing the spines from which its common name derives

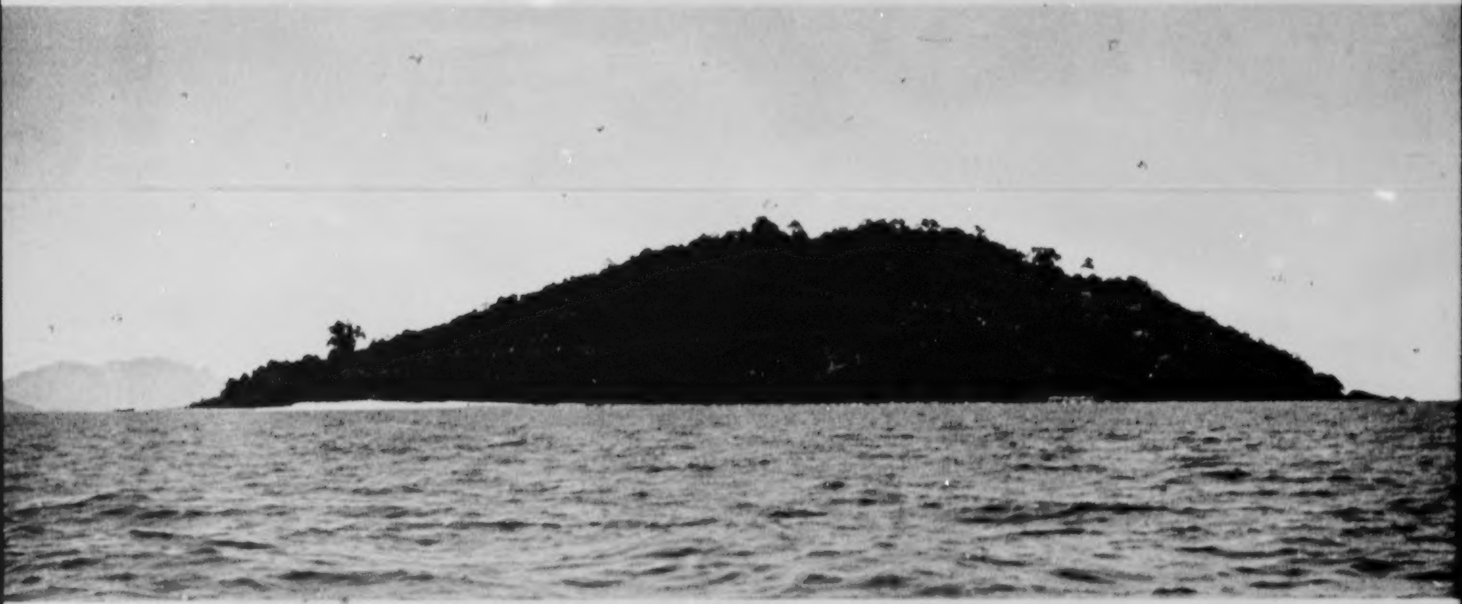


Figure 2.29: Dunk Island

Figures 2.30 and 2.31: The wilds of the Barrier Reef

Fishing has always been a very important industry of the area and the market is growing. In 1968-9 over a million kilograms of fish (including crabs) was caught commercially from the reef area. Does the food chain indicate the way in which too much fishing of the area might be dangerous? Coral and shell sales are also valuable; most tourist islands have officially banned the collection of corals and shells, but collections are still made elsewhere.

The use of coral as a source of limestone has been suggested, and there are vast amounts available. Should the reefs be mined for limestone, superphosphate and other valuable minerals which can be found in the area? Another possibility is that the reef will be systematically drilled in a search for petroleum. Offshore drilling has been carried out in some places already. Should it be extended? Should it have been allowed in the first place?

Some people have suggested that the greatly increased activity of the crown-of-thorns starfish has been caused by man. One theory is that pesticides have destroyed natural checks on the crown-of-thorns population. The Commonwealth and Queensland governments' recent investigation of the crown-of-thorns problem stated:

> Several pesticides have been positively identified in many of the rivers of the tropical Queensland coastline, but none has been in more than trace quantities, well below the levels regarded as potentially harmful. The dilution factor when the river waters enter the sea would make effects in sea water even less likely.
>
> There are two processes which might counteract this. Firstly, there is some evidence of pesticide concentration in surface . . . slicks. . . . Secondly, it is now well established that some organisms accumulate persistent pesticides in their tissues to levels well above that in the outside environment.
>
> (*Report of the Committee on the Problem of the Crown-of-thorns Starfish*, 25 March 1971, pp. 16, 17)

However, no definite evidence has been produced to support the theory; the traces of pesticide found in reef life are claimed by the report to be 'insignificant'.

Another theory suggested is that a hardier strain of crown-of-thorns starfish has evolved and that this has resulted in an increase in its numbers. Some researchers have put forward the theory that those things which eat the crown-of-thorns starfish (its *predators*) have decreased in numbers due to pollutants and to the activities of fishermen and shell collectors. Thus, they claim, the populations of triton or giant trumpet shells and of the painted shrimp may have been affected. Dr Robert Endean supports this theory. There has also been a suggestion that blasting and dredging have destroyed animals and corals which could be consumers of the starfish eggs; thus abnormally large numbers of starfish have survived to become a plague on the coral polyps. The first reports of abnormal numbers of the crown-of-thorns starfish appeared in the 1950s and much damage was done to the reefs in World War II. However, many abnormal concentrations of the starfish have been found in areas that have not been affected by dredging or by blasting since the war. In addition, some areas which have been affected by explosions or dredging have not produced large populations of the starfish.

Another theory is that, however subtly, the environment of the Great Barrier Reef has changed naturally so that conditions now favour the crown-of-thorns starfish. There is some evidence that the western Pacific Ocean was warmer than normal just before the first records of an increase in the starfish population. However, it is difficult to explain how this could have affected the starfish and not other plants and animals as well. Another theory is that the crown-of-thorns outbreak is just part of a normal rise and fall in their numbers. The government report favours this theory. There is some evidence of increases earlier in this century, and the plague has also occurred in other areas of the Pacific such as Guam, Fiji, the Palaus and Rabaul. However, we have no way of knowing whether the previous increases were of the same extent as those now occurring.

The most startling aspect is that we simply do not really know what is causing the plague. The government inquiry admits our lack of knowledge, yet claims that 'the crown-of-thorns starfish . . . does not constitute a threat to the Great Barrier Reef as a whole. . . . The entire living cover, or even a large proportion of the coral cover of the Reef, will not disappear as a result of [crown-of-thorns] activity' (p. 6). Do you accept these judgments? What is your theory?

Dr Endean, who surveyed the reef, recommended that collectors be appointed to gather the crown-of-thorns starfish, that more giant tritons be imported, and that a ban be placed on the taking of giant triton and giant helmet shells from the reefs. This latter suggestion has been carried out. Dr Endean also agrees that the starfish will not wipe out all the reefs, but warns that 'additional areas of the Great Barrier Reef will become infested . . . in the future if action is not taken now to control [it]' (*Report on investigations made into aspects of the current* Acanthaster planci *(Crown-of-thorns) infestations of certain reefs of the Great Barrier Reef*, Fisheries Branch, Qld Dept of Primary Industries, 1969, p. 35).

Refer back to the diagram showing the food chain for coral reefs in the Marshall Islands (figure 2·25). Where (if at all) does the triton shell fit into the diagram? Where do people fit into the diagram?

FURTHER ACTIVITIES

Debate

Your class might arrange a debate on the Great Barrier Reef. The question could be 'Should the Great Barrier Reef be conserved?', or 'Are people ruining the Great Barrier Reef?' The previous section will give you some material to read to support your arguments. The newspaper articles included here may also be of assistance to you. Your teacher's slide set and the many relevant books and articles in magazines and newspapers will also be of value to you.

Set up a parliament, and debate the question 'That an industrial mining company be allowed to work the Great Barrier Reef'.

Discussion

What justification can you give for retaining the Great Barrier Reef in its natural state? What reasons can you give for allowing the fish and materials of the reef to be taken and used? Is it possible, in your opinion, to have a satisfactory combination of the two positions? How?

'To achieve a better and fuller life, it seems to me necessary that we look beyond the value of a project in terms of money. Instead, we should ask whether or not certain things are necessary for a better and fuller life regardless of their value in dollars. We will need to weigh carefully those alternative uses of land which are valued on monetary grounds; some uses which produce monetary gain may not be the best uses of the land. We require a self-restraint which can come only with the development of a conservation attitude and a willingness to judge some things not in our bankbook but in our heart.'

(Abstracted from Leopold, Luna B., in Barton, I., and Kates, R. W. (eds) : *Readings in Resource Management and Conservation*, University of Chicago Press, 1965, p. 557)

Reef plan can save you $75

A MAJOR breakthrough in Australian package holidays has been achieved by Trans Australia Airlines in conjunction with five of the main resorts on the Great Barrier Reef.

The fiercely independent resort operators have for the first time, agreed to one common price for accommodation, all meals and some sightseeing cruises.

This has been incorporated by TAA into a series of holidays that represent a saving of up to $75.

As it is an experiment, the offer lasts from mid-September to mid-December but this period includes the Barrier Reef Festival, something of a highspot on the tourist calendar.

The common price agreement has enabled TAA to produce a brochure that is a wonder of simplicity when compared with the intricate tabulations usually contained in both domestic airlines' presentations.

The five resorts involved are Daydream, Happy Bay, South Molle, Lindeman and Brampton. A recent visit amply demonstrated that all have recovered fully from the devastation caused 18 months ago by Cyclone Ada. That is now but a sad memory and everyone hopes the public, too, has forgotten — or at least appreciates it was a once in a lifetime occurrence.

Despite TAA's reluctance to categorise the resorts, there is little doubt each has its own special type of [illegible].

All types and all ages can be seen happily enjoying all five resorts — but there are obviously some people who would be happier at one resort in preference to the others.

Happy Bay, for example, is very well suited to the family with young children. It is run by a family and has preserved the close-knit family atmosphere.

Its long, wide, sandy beach slopes gently into shallow water — the ideal kiddies' playground.

The resort's pride and joy is a large new lounge and entertainment area. Every night is entertainment night but rather than have a rigid programme it is arranged according to the demands, and the mood, of the guests.

At South Molle there's a greater emphasis on young people and night-life. The resort even puts its clocks back an hour so that there are more hours of darkness for those lured into the dimly lit Smugglers Den.

South Molle also has the best (but not the most attractive) swimming pool on the islands, a testing six hole golf course and a wide range of aquatic diversions including scuba lessons.

The most attractive swimming pool is at Daydream where the entire accommodation section is built around its long meandering edges.

Daydream the most sophisticated of the resorts offers the highest overall standard of accommodation.

Its range of amenities is considerable and even includes a pre-breakfast comb-up service in their rooms for female guests.

Brampton is the largest of the five resorts and is closest to the idea of a large hotel with plenty of activity and many more people.

It probably attracts the widest cross-section of people and is strong on honeymooners. A full-time entertainments hostess keeps the fun bubbling along and there are plenty of deserted sandy coves for anyone wanting to go off on their own.

Finally there's Lindeman — complete with its own air service and now boasting what must surely rank as one of the most beautiful golf courses anywhere.

Lindeman now has a large dam stocked with fish which is the habitat of many of 85 species of birds living on the island.

Good food, good service and good presentation are the hallmarks of Lindeman, which, although it offers all the facilities for a phrenetic night-life, tends to attract those seeking complete relaxation in exotic and warm surroundings.

Choosing one resort in preference to another is very much an individual choice and a case of knowing the type of holiday you most want.

And no matter which one you choose you'll get plenty of chance to explore the other on the various day cruises included in the cost of $232 for seven, $262 for 10 or $303 for 14 days.

Plan for the Reef

IN the Great Barrier Reef is a unique national asset which Governments, both State and Federal, have too often undervalued. Queensland, hungry for revenue and tantalised by the prospect of a major oil strike off its coast, has been reluctant to move against the oil companies to whom it granted exploration licences; and it resisted almost to the last the idea of a joint Federal-State inquiry into the dangers to the Reef from oil drilling. The same Government has been reluctant to concede the threat to the Reef from two other directions — the Crown of Thorns starfish and tourist development (if that is the right word to describe the vulgar unchecked sprawl which confronts visitors to some of the Reef islands).

What is needed, conservationists have been claiming, is legislation to protect the Reef against reckless and damaging exploitation by self-interested firms or Governments. An American firm of consultants, engaged by the Australian Tourist Commission, has reached the same conclusion. The firm's report, based on 12 months investigation, says the Reef must be protected against unplanned and uncontrolled development. It suggests that this be done by declaring the Reef a marine reserve, administered by a specially created authority.

The formation of such an authority would not be without its difficulties. There is the problem of conflicting interests between Queensland and the Federal Government. There is the more general problem of conflicting interests within the State itself: between commercial development, including tourism, on the one hand and conservation on the other. The authority, which would presumably be broadly based and representative, would need to lay down precise guidelines for commercial exploitation; it would also need to rule on the contentious question of oil drilling, though in this it will eventually have the Royal Commission's findings for guidance. Nonetheless, the principle of a marine reserve or maritime national park is a sound one. It offers some guarantee that the Reef will be preserved for the use and enjoyment of all Australians, not merely those who happen to live north of the Tweed River.

3

A swamp environment

Where is Kerema Bay? Describe its location by using your atlas and the large-scale map (figure 3·1). The area shown on the map is the home of two distinct groups of people.

The coastal strip is occupied by the Elema people who build their villages along the coastal sand dunes. The Elema villages are comparatively large for Papua, and near the mouth of Kerema Bay there are four villages each with a population of about 500 people. Contrasting with this comparatively densely settled coastal strip are the inland areas of swamps and mountains. The swamps support no permanent villages; the mountains are the home of a little-known group of people called the Kukukukus. The Kukukuku people live in scattered groups of three to five families and are semi-nomadic, constantly moving their villages. Can you suggest why the Kukukuku are constantly moving? Why do they live in small groups?

Can you locate *both* Kerema and Murua in figure 3·2? If not, why not? Make a sketch from the aerial photograph showing the river and the settlements. Why does the colour of the river vary in different parts of the aerial photograph?

Until recently the Kukukuku people and the Elema people had little contact with each other apart from the raids which the Kukukukus made upon the coastal villagers. Why were these raids made? However, with the spread of the Administration's influence this raiding has ceased, and now coastal and mountain people mix in the township of Kerema or the agricultural station at Murua. Nevertheless, apart from some trading, the two groups still have little contact with each other.

The uninhabited area of swampland formed a barrier between the Elema and the Kukukuku peoples. It was of no use to the mountain people, but it was an important source of food and building materials for the coastal people. Although fearful of the mountain raiders, the Elema or Kerema Bay people have for generations paddled their canoes up the rivers and creeks to hunt fish and gather food from the swampland. Nowadays these trips are made without fear of attack and, in fact, some of the coastal people have built houses along the banks of the rivers. See figures 3·3 and 3·4. What are the advantages of having a house by the river? What could be some disadvantages?

The swamp environment

Papua is in the tropics. There is no summer or winter, the temperature of the coldest month being only 2°C different from that of the hottest month. In the early afternoon, the temperature reaches about 29°C and during the night it falls to about 23°C. What are your area's hottest and coldest temperatures? What is the difference between them (this is called the range of temperature)? Why is it greater than Papua's?

There is no dry season. The annual rainfall is approximately 3,600 mm. The wettest month, May, receives almost 430 mm and the driest month, December, receives almost 200 mm. Throughout

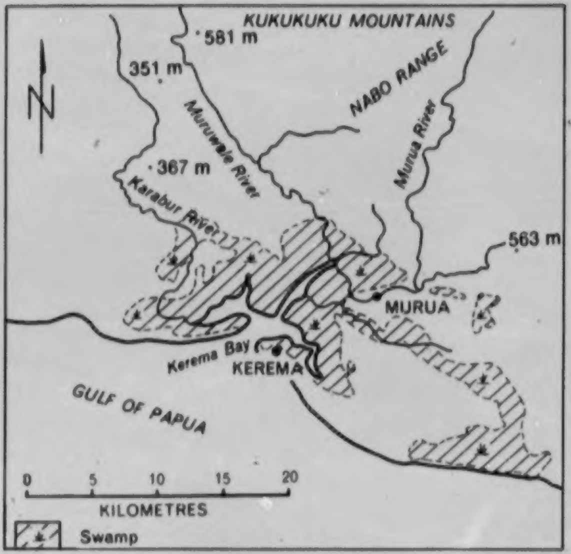


Figure 3.1

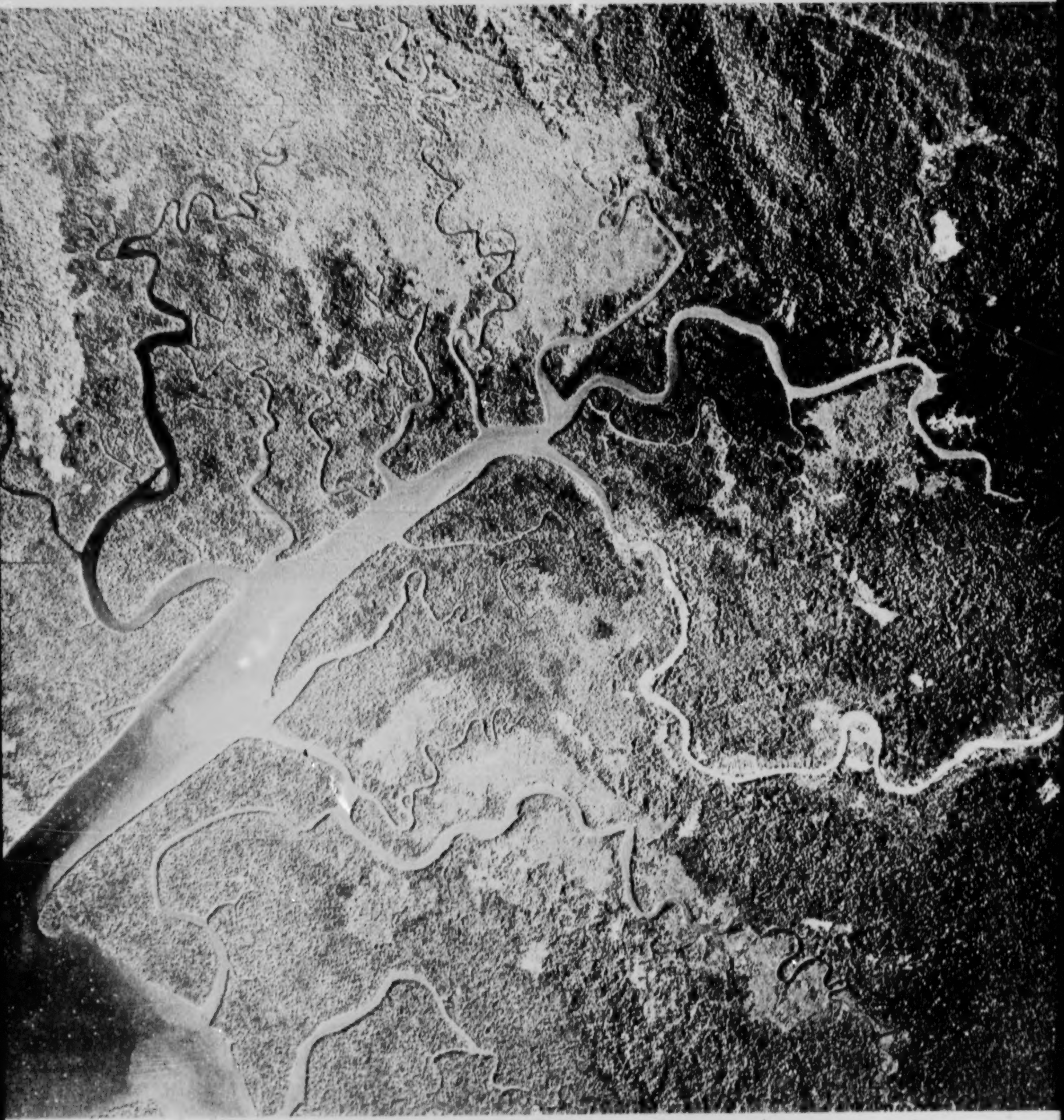


Figure 3.2: Aerial photograph of part of the area shown in figure 3.1, with which the photograph should be compared to estimate its scale, orientation and area. The only signs of human habitation are the clearings for gardens, mainly along the banks of the Murua River. ***(Crown copyright—reproduced, by courtesy of the Director of National Mapping, Department of National Development, Canberra)***

the year rain falls every two or three days. What effect do you think this heavy rain would have on the soil?

These conditions favour the growth of forest vegetation, and the foothills are covered with rain forest. Dense vegetation grows in the swamp but, because of the constantly wet conditions, the vegetation is of a special type. There is, therefore, a close relationship between the climate in this area and the vegetation. What would happen to the slopes if the trees were cut out for timber? What would happen to the swamp?

Near the coast the rising tides flood large areas of land. The salt water flows along the shallow, winding, tidal channels and spreads across the mud flats which, at high tide, are covered by up to a metre of water.

Further away from the coast, the water is less salty and near the foothills the swamps are covered with fresh water. But even in the freshwater swamps, the rise and fall of the tides can be noticed as the incoming tide dams the flow of fresh water.

As a result of these conditions, there are three main vegetation zones within the swampland. In the saltwater tidal swamps the dominant vegetation is mangrove. The mangroves form a dense canopy of leaves, but the ground is bare except for the tangle of roots and breathing stems of the mangroves. Where the water is less salty (that is, brackish), the nipa palm grows along the banks of the waterways together with a different species of mangrove (see figure 3·6). In the freshwater swamps the dominant plant is the sago palm which grows to a height of 15 to 18 metres. Make a sketch map, like the one showing population distribution, to show the distribution of the different kinds of vegetation.

Food from the swamps

The waterways are a good source of fish. There are many varieties of fish in the bay because of the varying amounts of salt in the water. The fish are caught by line, by spear, and sometimes by a net stretched across a channel. Shellfish, gathered from the mud flats and mangrove areas, are bivalves approximately 5 cm across. It is usual

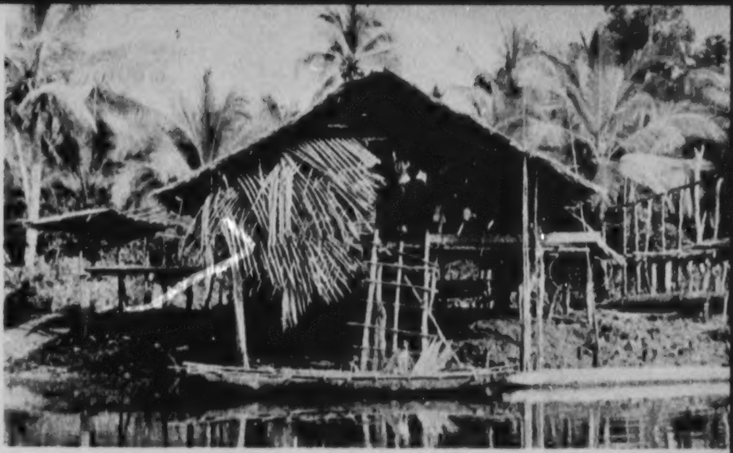


Figure 3.3: A temporary house on the river bank near a freshwater swamp. The family is about to set off for a day's sago-making. The palms are coconuts planted in a clearing

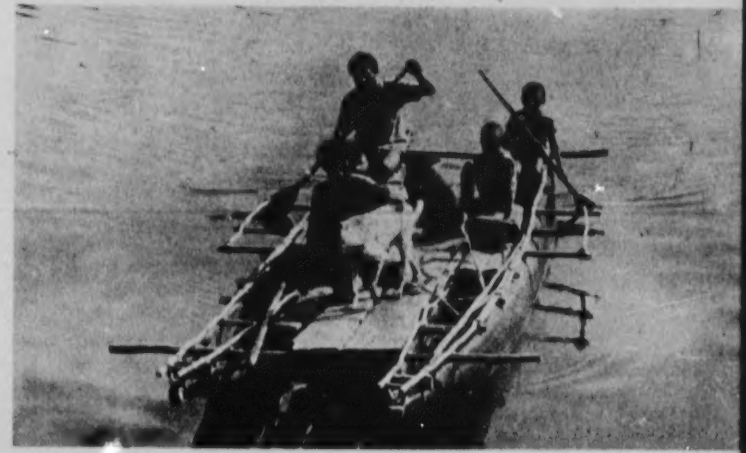


Figure 3.4: Most transport is by canoe. The canoe consists of two hulls made from hollowed-out logs and lashed together by a framework of light sticks. Larger single-hulled canoes are frequently propelled nowadays by outboard motors

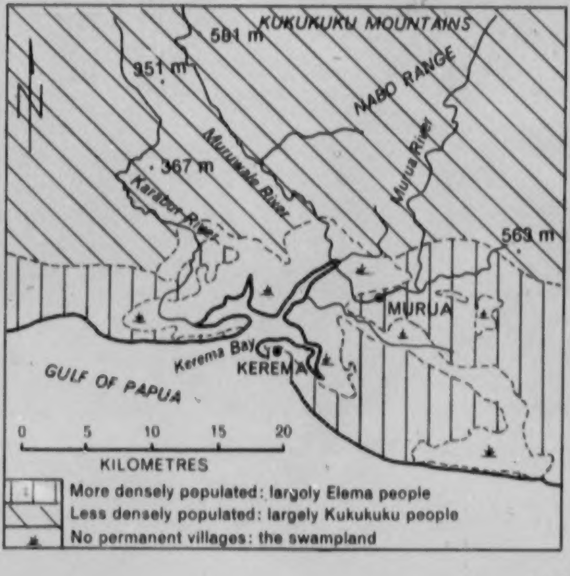


Figure 3.5: Describe the distribution of population in this area using this sketch map and figure 3.1. (The study of distributions refers to the study of the locations of a number of an element taken together. For example, we could study the location of one factory or the locations of many factories at the same time—in the latter case, we would be studying a distribution)

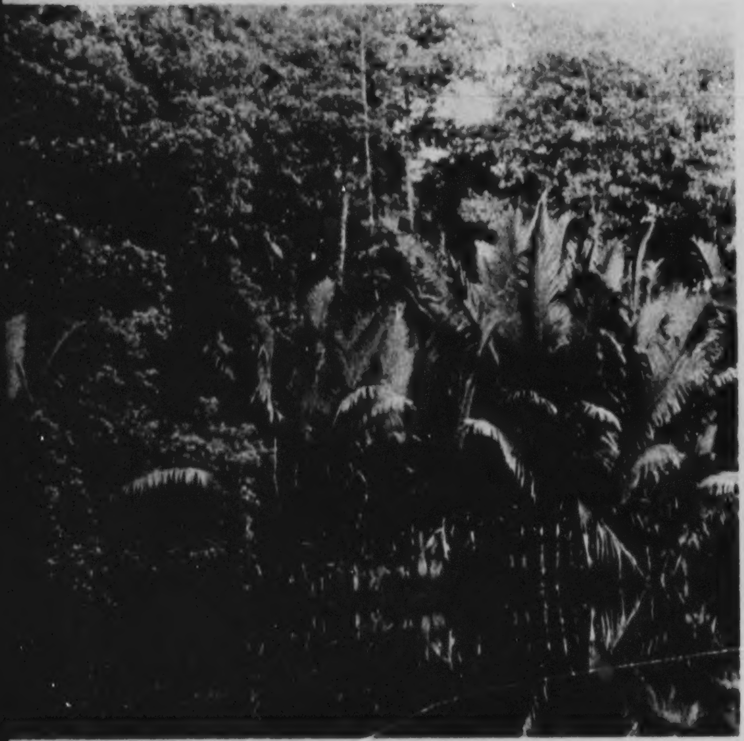


Figure 3.6: The waterways are lined with a tangle of swamp vegetation. The small palms are nipa and the trees are mangroves

Figure 3.7: Sago-making. The man chips the pith of the sago palm into small flakes. The bark has been peeled off half the trunk so that the sago flakes do not fall into the mud

to cook the shellfish simply by placing them, still in their shells, in the ashes of a fire. Another way of preparing the shellfish is to place them in boiling water. When the fish opens its shell, it is removed and cooked with coconut oil in another pot.

Until recently crocodiles were also caught, but the high prices obtained for their skins resulted in most of the crocodiles being destroyed. There are now regulations governing the shooting of crocodiles in an endeavour to save them from extinction. The trunk of the mangrove is the home of a long grub which is gathered, cooked and eaten. Crabs, also, are gathered from the swamps. The crab is usually not killed immediately but is bound with fibres and kept alive until it is to be eaten. Why is there an abundance of animal life in the swamp? Where does the food for this life come from?

Food and materials from swamp plants

The vegetation of the swamps is an important source of food and building materials. The nipa palm has a reddish fruit which is gathered and eaten raw. Occasionally, the tender, young shoots are cooked as a green vegetable. The leaves of the nipa palm are valuable for thatching. The leaves are stripped from the frond and the individual leaf is bent double over a strip of bamboo. The leaf is held in place by a splinter of wood or a thorn from the palms. Battens of thatch about a metre in length and about 40 cm in width are then laid, with one batten overlapping the other, on to the rafter of the roof. This thatching is waterproof, cool and usually lasts several years.

The most valuable plant in the swamps is undoubtedly the sago palm. Areas of sago palm are owned by different village groups and ownership of the palms is jealously guarded. The man and the woman who are shown making sago in figures 3·7-3·9 were only allowed to do so because the palms belonged to a relative of the man.

After growing for about 20 years, the sago palm puts out a huge flower (figure 3·10). At this stage, the starch content of the palm is at its maximum. The palm is felled and the outside bark is peeled off the trunk, which is about 9 metres in length. The palm is then ready for sago-making.

This is done by a man and his wife, although another female relative sometimes assists. The man chips the pith of the trunk into small flakes, using a simple triangular-shaped tool which has a cutting edge fashioned from a piece of steel pipe. The flaked pith is then carried to a stand where the starch is washed out.

The main part of the stand is one of the large fronds of the palm. The trough-like frond is supported between crossed sticks so that the broad end is uppermost. The narrow end hangs over a trough made from the fibrous layer of the black palm. The fibrous material is shaped into a shallow dish by sticks which are driven into the ground. A lip or spout is made so that water can drain off.

The woman beats the pith with a stick and then pours water obtained from a shallow hole in the ground over the pith; she next squeezes the wet pith and forces out the fine, flour-like particles of sago. An ingenious triangular-shaped strainer made from fibres obtained from the coconut palm permits the sago and water to run into the catching trough while the coarse material is held back, to be thrown away. The sago then settles in the trough and the water flows away. It is a day's work to make a trough of sago weighing about 30 or 35 kilograms. A sago palm yields about 225 kilograms of sago.

At the end of the day, the sago is carried back to a temporary house on the river's edge where the family lives while engaged in sago-making. After drying, the sago is stored until required. Sago is eaten in a variety of ways. It can be wrapped in nipa palm leaves and roasted. Often small fish or coconut oil are added for flavour. It can be mixed with water and cooked in a frying pan, after which it resembles a crisp pancake. The sago, when boiled in water, becomes sticky and the kernel (or meat) of the coconut is scraped on to it. Another way is to use the sago as thickening for the water used for boiling fish or vegetables such as sweet potatoes, taro, and cooking bananas.

The sago palm is useful in other ways. Thin strips of the bark are cut into lengths about 25 millimetres across and about 3 millimetres thick. These strips are woven to form sheets used as walls in houses. What could be a main use for the leaves? One other use, which is now declining, is to shred the new leaf into thin fibres and make these into grass skirts. The Elema people rarely do this nowadays, preferring to buy cotton clothing from the trade stores. The grass skirt, however, is still a common form of dress for the

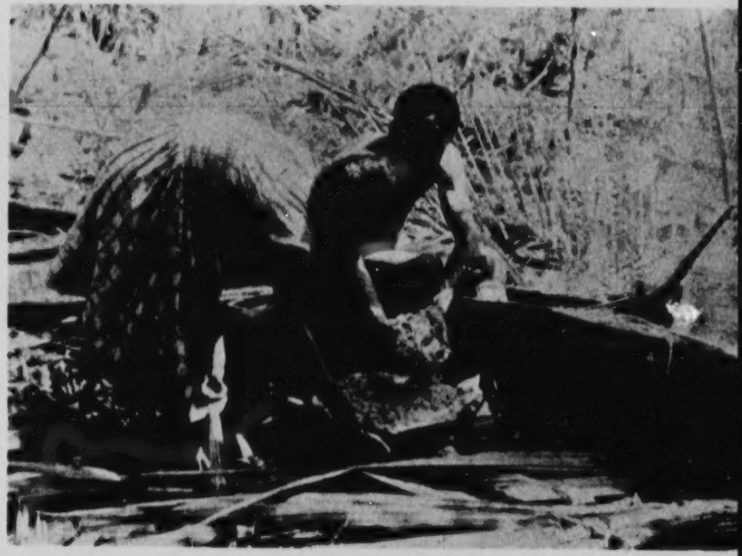


Figure 3.8: Sago-making. The flaked pith is placed in a carrier made from a leaf

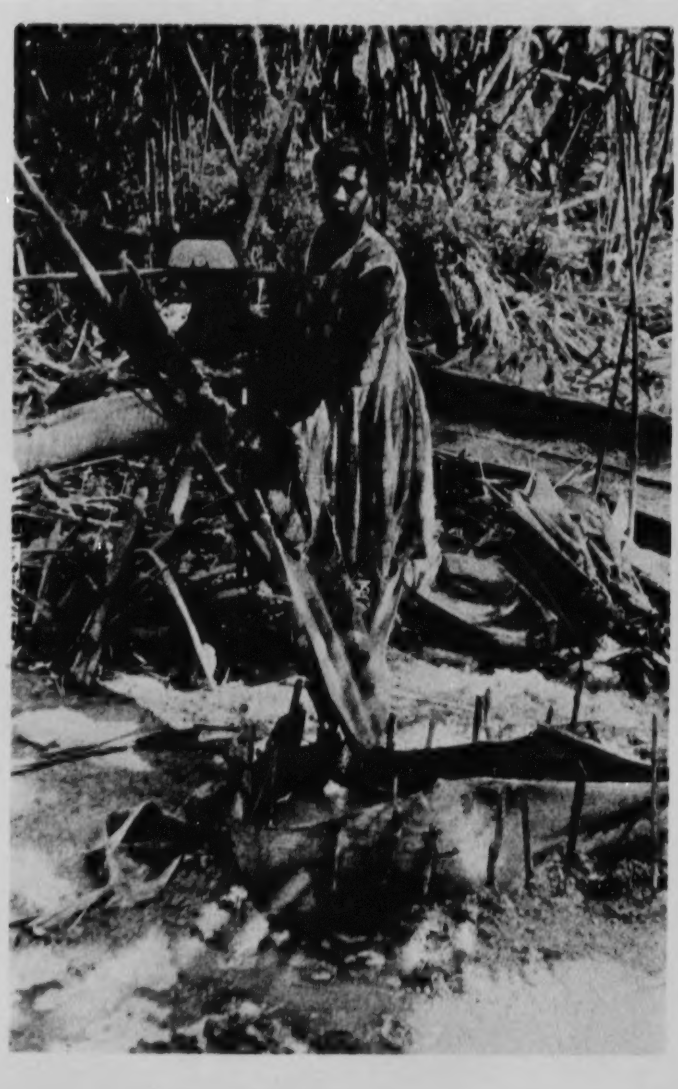


Figure 3.9: Sago-making. The sago is washed from the pith. The leaf which was used for carrying the pith is on the ground; the enamel basin is used for lifting water on to the pith. The large leaf in which the sago accumulates is held in position by small sticks. Here the woman is squeezing the sago from the pith. The sago runs through the triangular-shaped strainer; the coarse material, which cannot flow through, is thrown away

Figure 3.10: The large flower of a sago palm

Kukukukus. Make a diagram to show the production of sago and the use of by-products. The diagram has been started in figure 3·11.

Markets

Markets are now held in the township of Kerema and at the agricultural station at Murua. At these markets there is a three-way trade. The Administration employees — teachers, clerks, drivers, nurses, etc. — buy food from the Kukukuku and Elema peoples. The Kukukukus sell garden produce which is grown in the foothills and brought by canoe to the market. The Elema people mainly sell coconuts and seafoods — fish, shellfish and crabs (figure 3·12). With the money obtained from the people who are paid a cash wage, the Kukukukus and the Elema trade with each other. Study figures 3·3, 3·9, 3·12 and 3·13. Are the Kerema Bay people wealthy? Explain your answer by referring to the photographs.

Townships

Kerema, a town of about 1,200 people, is the administrative headquarters for the Gulf District of the Territory of Papua. It is built on a low ridge which runs in an east-west direction between the coast and the swampy edges of Kerema Bay. Murua, an agricultural station, is built on the dry land formed by the levee banks of the Murua River. On one side of the station is the Murua River which flows into Kerema Bay, and on the other side is a large expanse of freshwater swamp. The Murua agricultural station serves a settlement of coastal people who have moved into the foothills to grow rubber.

The only access to Kerema or Murua is by water or by light aircraft. There are no roads through the swamps, and travel by foot is made virtually impossible by the tangle of palms with their sharp thorns, the tangle of roots of the mangroves and the mud of the channels and flats.

The swamp environment has generally repelled human settlement. The saltwater, the brackish and the freshwater swamp environments differ from each other, but each type of environment is able to provide some food and building materials. The surplus food obtained from the swamps by the coastal people is traded to the town-dwellers and the mountain-dwelling Kukukukus, whose gardens in the foothills yield a surplus of vegetables such as taro, sweet potato and cooking bananas. These bulky, heavy goods are transported by canoe along the waterways. Draw a simple diagram, using labelled arrows, to show the system of trade between the town dwellers, the coastal people and the mountain dwellers. As you can imagine, very few goods have to be brought into this area. Name some of

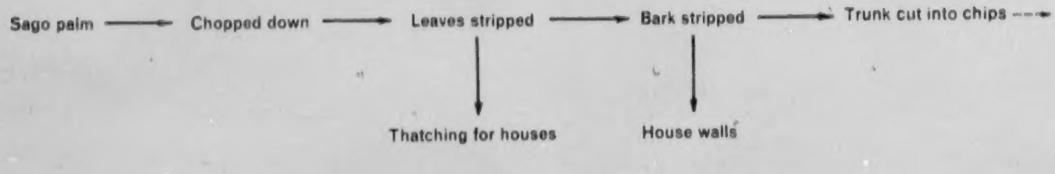


Figure 3.11

Figure 3.12: The market at Murua. Coastal people display crabs and shellfish collected from the swamps. How are goods bought and sold in this market?

Figure 3.13: The house of a Kukukuku family. The roof and linings of the wall are made of thatch. A batten of thatch ready for use is hanging on the wall. Why are houses made of nipa palm thatch and not of more permanent materials?

them. What goods are available for sale outside it? Could we say that there is a very close balance in this area between man and his environment?

FURTHER ACTIVITIES

1. List the changes you would make if you were appointed administrator of this area for a three-year period.
2. Visit a swamp in your area and make a sketch map of the distribution of the kinds of plants and animals you can observe. Why are these plants and animals where they are? Is your sketch like that shown in figure 3·14?
3. How far do you travel each day? Do you go further afield in the holidays? What is the furthest distance you have ever travelled?

How much of Papua do you think a Kukukuku boy would know? Would he know more or less of his country than an Elema boy? Why?

How would you define your 'home area'?

If you were visiting America for two years and were describing your home area to American friends, how large an area would you be referring to? Try to estimate this in square kilometres. Would an Elema boy, on a scholarship to America, be describing a larger or a smaller area than you? Approximately how much larger or smaller would his area be?

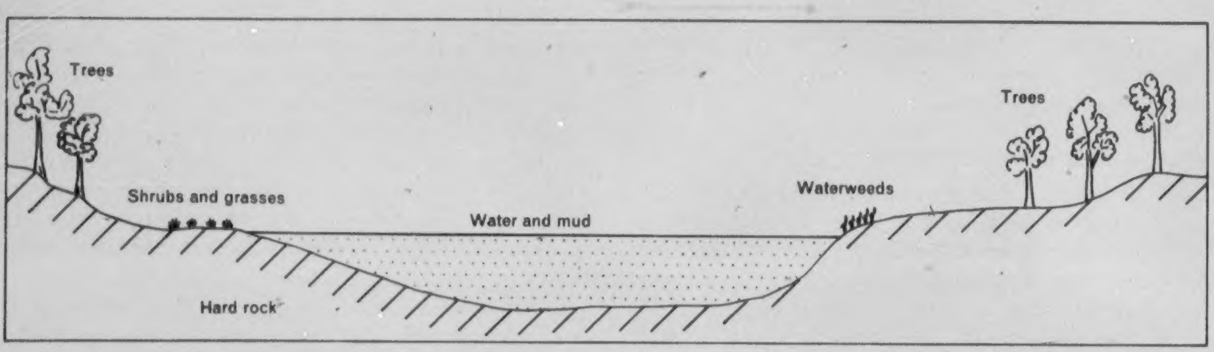


Figure 3.14

4

The farming system: a market garden

In the previous three studies you have been considering various examples of the physical environment and the systems that exist within it with very little influence from man. For example, you have seen how the rainfall affects vegetation and the animal life in an area. Now it is time to look at some of the differences that man can bring about. Before he started working in factories, man was a farmer. Farming is often slow to change. You will see this important point illustrated from different parts of the world in Level Two of this series. How does man develop his farming methods, and how are improved farming methods established? This will be investigated in the next three studies. Probably you think of a farmer as being the head of a family living on one farm. This is not always the case, as these studies will show.

A market garden is a very busy place. Have you ever seen one? Look at figure 4·3. This view was taken from a light aircraft flying at about 250 m. The market garden we are going to look at is in this photograph. Try to find it, when you have a clearer idea of what the farm looks like.

The carefully organised paddocks of vegetables stand out clearly: the dark greens of carrots and parsnips, the grey-green of the cabbages and leeks, and the pale lettuce. There is the farm dam, and between it and the main road are the farmhouse and sheds. Paddocks of grey and brown soils mark the position of temporarily fallowed land and newly harvested crops.

This farm is on Tootal Road, Dingley, about 23 km south-east of Melbourne (see figure 4·1). Name those suburbs of your home town where market gardens are found.

What is a market garden like?

Look at figure 4·2 — a vertical aerial photograph taken early in 1970 by the Victorian Department of Crown Lands and Survey from an altitude of 1,550 m. This photograph shows an area around the market garden, with the market garden marked on it. The photograph shows many types of land use — other market gardens, a trotting track, quarries, factories, residential areas, other types of farming. Try to identify all the types of land use marked with letters. It is rather unusual to find all these types of land use in the same place.

Most market gardens are near cities because they earn so much more from the land than other types of farming. However, they cannot compete for long against the residential area and the other expanding land uses (factories, roads, freeways, shops, power supplies). As the land values rise rapidly, the rates paid to the local council also rise, and thus as cities move out so do the market gardeners, staying near the urban fringe nevertheless. Some market gardeners may start as many as four new farms in their lifetime.

As you can see from figure 4·2, the farm is really divided into two sections by the road. This farm is 9 hectares in area. Compare this with the sizes of other farms treated in this book, and farms of which you have personal knowledge. Is this farm small or large? Look at figure 4·2 — in the south-west corner is a grazing farm. What is its size compared to the market garden? How can one farmer make money out of a farm of only 9 hectares, while other farmers need 50 or 500 or 5,000 hectares to make money? Because the land is so costly close to the city, and because of the demand for land by other types of land use, market gardens need to be small. How can they make a living? Follow the farm description carefully, and see if you can find the answer.

On this farm three men work the land continuously, carrying out ploughing, harrowing and the skilled tasks of planting, thinning, tending and finally harvesting the crops. The three gardeners can be seen in figures 4·4 and 4·5; the owner of the farm is driving the tractor. Since the farm is 9 hectares in area, the employment of three gardeners means that there is one man for every 3 hectares. How does this compare with other forms of farming?

Though new chemicals (to control diseases and weeds) and new machinery are being introduced, they have not greatly affected the need for labour.

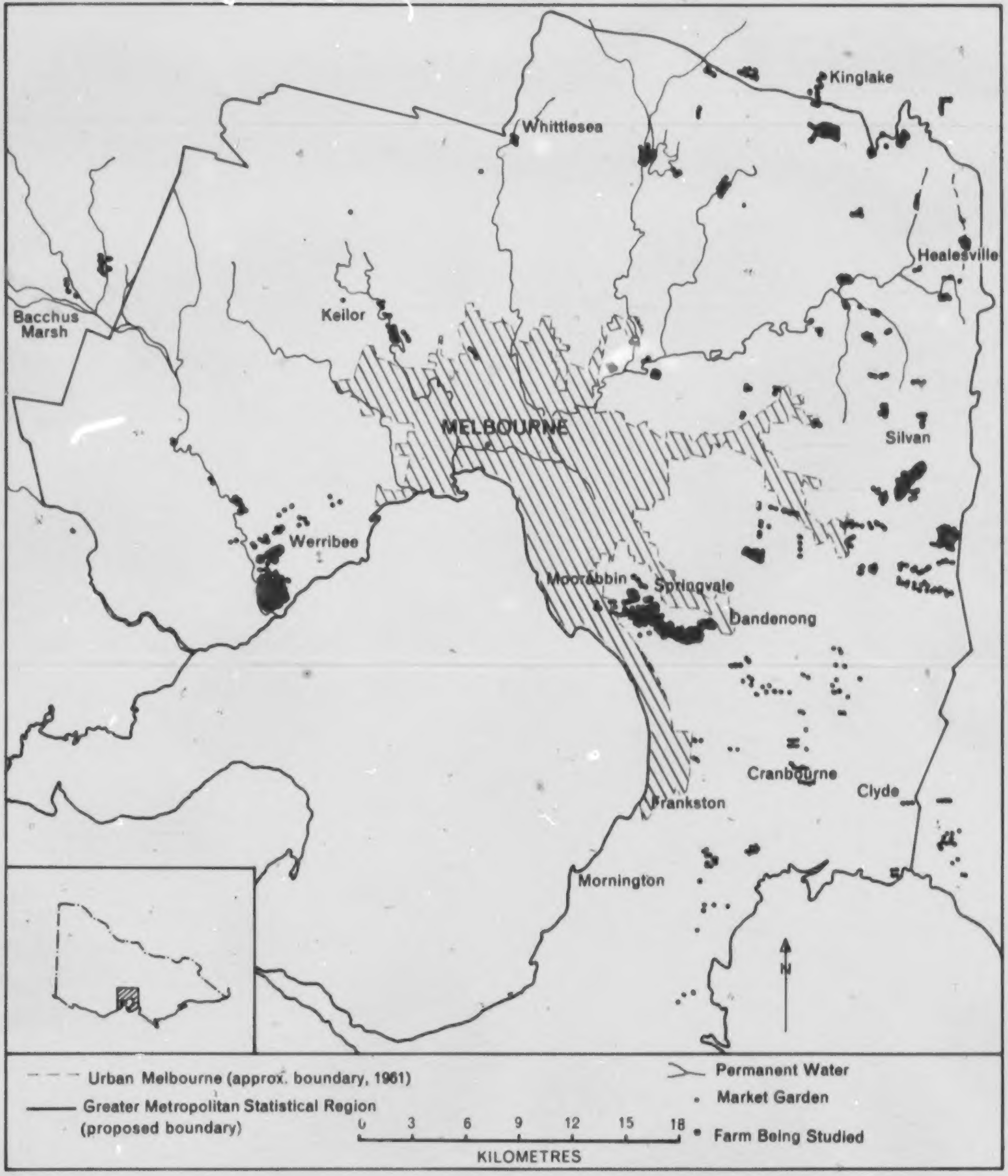

Kinglake
Whittlesea
Healesville
Bacchus Marsh
Keilor
MELBOURNE
Silvan
Werribee
Moorabbin
Springvale
Dandenong
Cranbourne
Clyde
Frankston
Mornington
N
Urban Melbourne (approx. boundary, 1961)
Greater Metropolitan Statistical Region (proposed boundary)
0 3 6 9 12 15 18
KILOMETRES
Permanent Water
Market Garden
Farm Being Studied

Figure 4.1: Location of market gardens around Melbourne (Source: J. L. Sach, ***The Changing Location of Victorian Vegetable Producers, 1950-1969****, unpublished honours thesis, Monash University, 1969)*

Farmers can increase production on farms in a number of ways:

- Use fertilisers and manures to 'feed' the crops
- Use added water to provide sufficient moisture.

(Refer to table 4·1 on page 36.)

What is the total tonnage of manures and fertilisers applied per hectare? What is the total for the whole farm? What is the total cost per hectare, and for the whole farm? The final column indicates the knowledge the farmer must have of crop needs at various stages of their growth.

In addition to the application of large amounts of fertilisers, heavy irrigation of the crops is necessary for as much as six months of the year. Most farms have dams which they fill from water mains and any run-off from the farm. Locate the

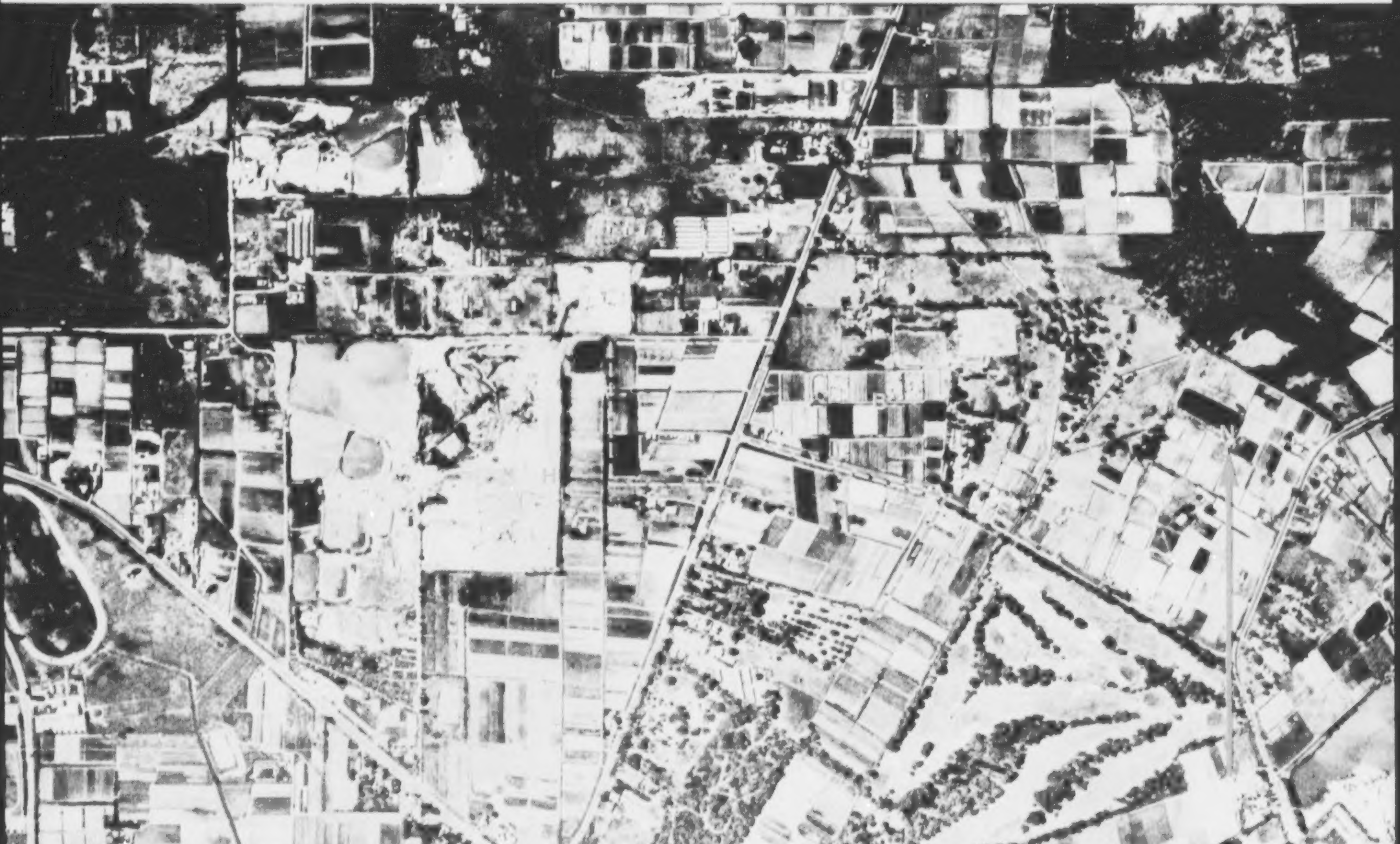

H
F
200 100 0 100 200 300 400
METRES

Figure 4.2: Competing land uses in the market gardening region south-east of Melbourne **(Dept of Crown Lands and Survey, Victoria)**

A.

Figure 4.3

Figure 4.4: Harvesting potatoes. Rather than attempt the laborious task of hand-digging, all modern farmers use 'lifters' or 'spud-diggers', to harvest the crop. Towed by a tractor, the 'lifter' has a blade which cuts beneath the potatoes and throws soil and all on to a mesh. The soil is shaken off and the potatoes are thrown out at the back. For the lifter to work properly, stalks must be removed with a slasher—also powered by a tractor. As potatoes keep well in the ground, there is no rush to harvest them immediately unless, of course, the land is needed for another crop, or the demand for potatoes is high. The dried-off plants in the foreground will be slashed and lifted as needed

Figure 4.5: Boxing potatoes. Though a 'lifter' saves a great deal of time when harvesting, the skilled worker is still necessary. Here, two gardeners follow up the tractor work by sorting and boxing the crop

Figure 4.6: Manure ready for spreading

Figure 4.7: Spray irrigation

Table 4.1: Use of fertilisers and manures per hectare per year on the Dingley sample farm

Fertiliser or manure type	Cost per tonne (1,000 kg)	Av. amount per hectare	When applied
Poultry manure	$12	5-8 tonnes	Immediately after planting seed of every crop. This is gradually washed into the soil but also reduces evaporation
Stable manure	$24	25 tonnes	4 weeks before planting each crop
Straw	$24	12 tonnes	With poultry manure each year
Lime	$26	500 kg	Before planting, once a year
Ammonia	$66	A total of 380 kg	Several dressings on every crop: when 2-3 weeks old, when half grown, and 3 weeks before harvest
Soda	$76		
Potash	$75		
Nitrites	$45		
Urea	$125	A total of up to 1,250 kg	At various times during the growing season: as needed on each crop
Blood and bone	$75		
Superphosphate	$25		

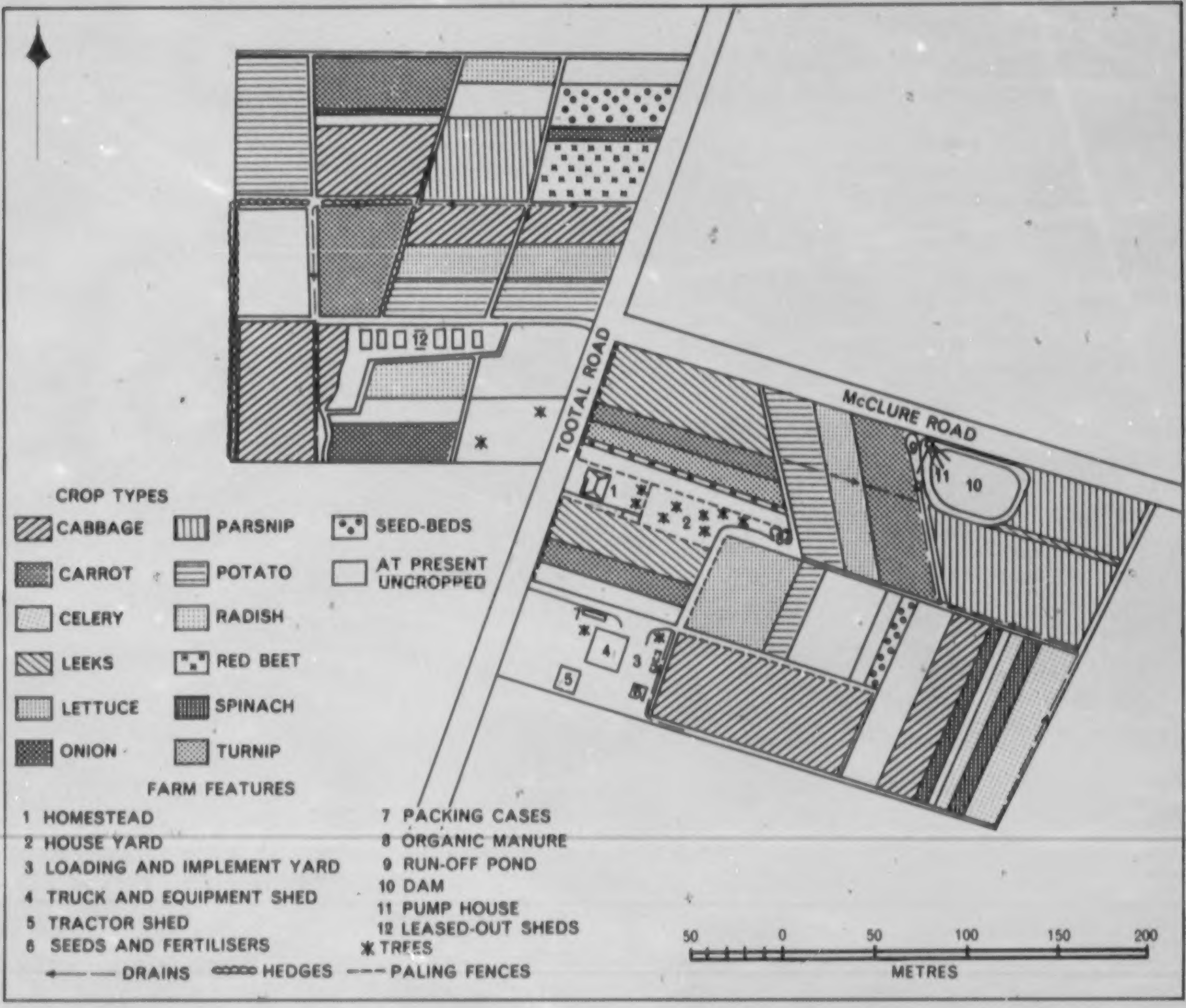

TOOTAL ROAD
McCLURE ROAD
1
2
3
4
5
6
7
8
9
10
11
12
CROP TYPES
CABBAGE
CARROT
CELERY
LEEKS
LETTUCE
ONION
PARSNIP
POTATO
RADISH
RED BEET
SPINACH
TURNIP
SEED-BEDS
AT PRESENT UNCROPPED
FARM FEATURES
1 HOMESTEAD
2 HOUSE YARD
3 LOADING AND IMPLEMENT YARD
4 TRUCK AND EQUIPMENT SHED
5 TRACTOR SHED
6 SEEDS AND FERTILISERS
7 PACKING CASES
8 ORGANIC MANURE
9 RUN-OFF POND
10 DAM
11 PUMP HOUSE
12 LEASED-OUT SHEDS
TREES
DRAINS
HEDGES
PALING FENCES
50
0
50
100
150
200
METRES

Figure 4.8: Cropping pattern on the Dingley sample farm, April 1971

dam of the sample farm in figures 4·2 and 4·3. How many other dams can you see in figure 4·2? Each year the farmer collects seven million litres of water off the farm and buys another forty million litres from the Melbourne and Metropolitan Board of Works. This costs at least $1,500 a year!

What do you now think might be the answer to the question about how this farmer could make a living?

Farming methods

A detailed map of the pattern of crops on the Dingley sample farm in late April 1971 is shown in figure 4·8. The farm paddocks are intensively divided up between the crops. Draw up a list of the vegetables grown on the farm. Which occupy the greatest part of the farm at this time of the year? By growing such a wide range of vegetables, the grower assures himself of a secure income. If one crops fails or has to be sold very cheaply, the grower can rely on income from other crops.

Crops are grown at all times of the year, once again to ensure a secure income, but perhaps most importantly to ensure that the high costs of running the farm are met. Of course, as the gardener supplies the city's constant demand for fresh vegetables, he must always have crops available.

To grow crops all year and to have fresh, mature vegetables always available requires a great deal of skill on the part of the market gardener. He must know when during the year the various crops will grow, how long they will take to grow and mature from their beginning as a seed or seedling, and how much of each vegetable can be sold each week. Without this knowledge, a farmer would fail very rapidly. Figure 4·9 shows when the various crops usually found on the sample farm can be grown. During which months are there more than ten crops being grown at the same time? When are there less than six crops being grown? What would be an important factor in the difference in the number of crops?

The vegetable grower neither wants to, nor could, sell all of his crop of a particular vegetable

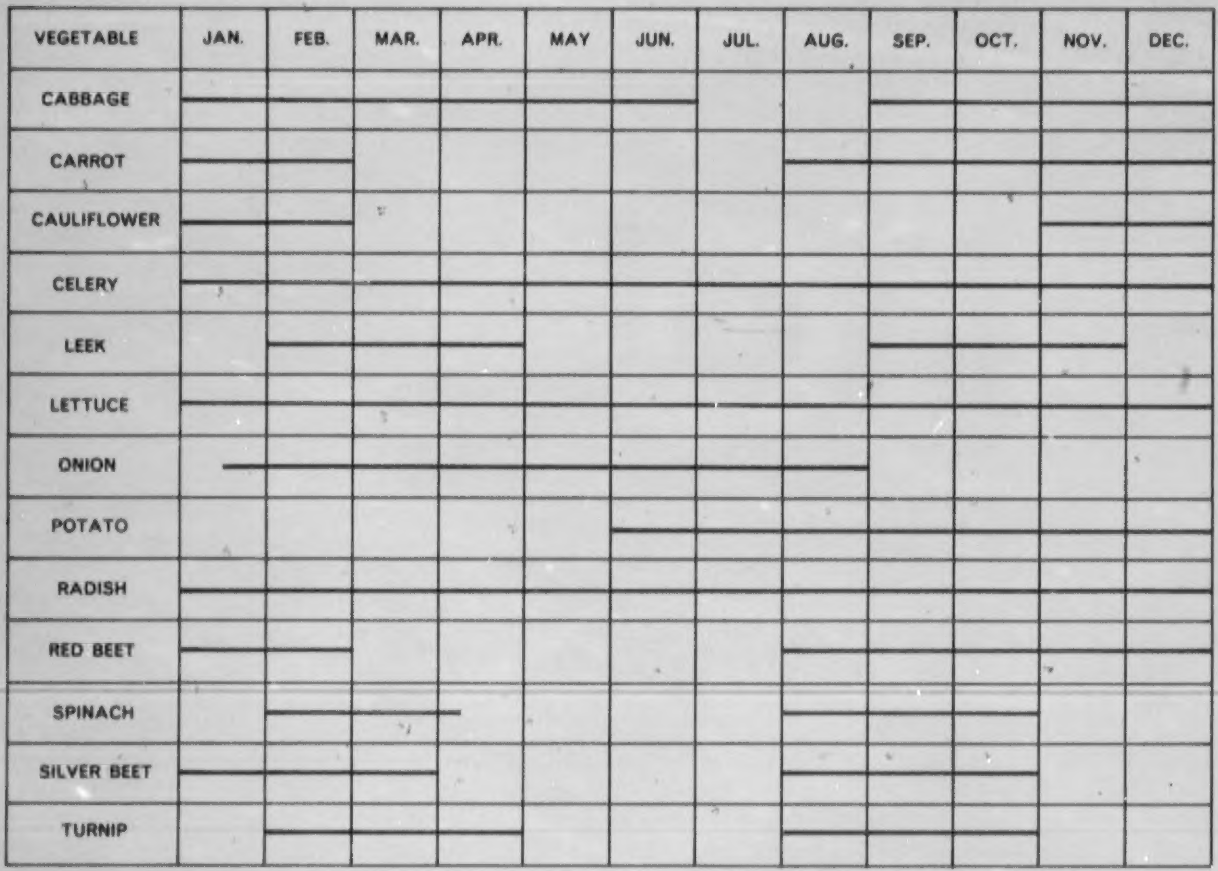


Figure 4.9: Vegetable planting seasons, southern Victoria

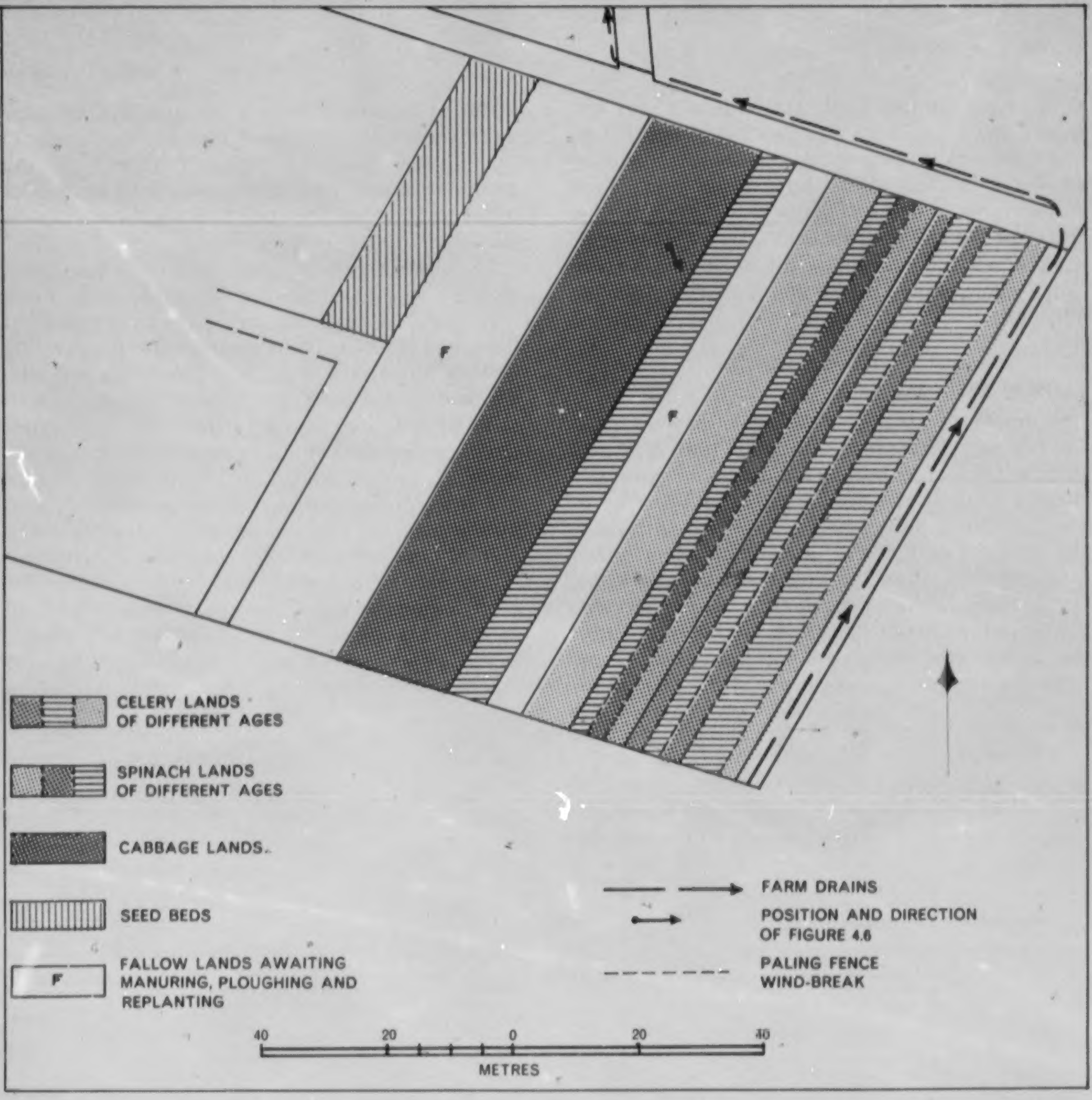

CELERY LANDS OF DIFFERENT AGES
SPINACH LANDS OF DIFFERENT AGES
CABBAGE LANDS.
SEED BEDS
F
FALLOW LANDS AWAITING MANURING, PLOUGHING AND REPLANTING
FARM DRAINS
POSITION AND DIRECTION OF FIGURE 4.6
PALING FENCE WIND-BREAK
F
F
40
20
0
20
40
METRES

Figure 4.10: Detailed cropping pattern on part of the Dingley sample farm, April 1971

at once. Thus, he staggers the planting of seeds and seedlings so that only small amounts of each vegetable are ready to harvest each week. Crops are not wasted, allowed to get too old, or harvested when too young. Figure 4·8, then, only tells us half the story of cropping patterns on the market garden. Figures 4·10 and 4·11 reveal a lot more. Meanwhile, the potatoes being boxed in figure 4·5 were planted a week before those which look brown and withered on the left side of the photograph; in figure 4·7, the middle cabbages have just been planted, those on the left are three weeks old, while those on the right are ready for market!

Because many vegetables only take several months to grow, the market gardener makes maximum use of his land by putting in a new crop soon after the previous one has been harvested. The huge amounts of fertiliser and manure make this possible. Thus, as the radishes on the farm are harvested, the land is progressively fallowed for a brief period, manured, and then planted to onions. Through the spring months, when the mature onions are harvested, the land will be put under lettuce. In this way, as many as three crops can be grown each year. This is very favourable when compared with one crop a year on most farms (for example, wheat), and only one every

Figure 4.11: Staggered planting of vegetables

Figure 4.12: Harvesting carrots

two years on a sugar farm. Each year, 20 hectares of vegetables are grown on the 9 hectares of our sample farm!

Such care in growing and such skill in planning the cropping patterns on a market garden should lead to very high production levels. If they don't, then the farmer will lose a lot of money. About 60 tonnes of vegetables per hectare are produced on the sample farm. Look at table 4·2. How are market gardeners able to make a living out of such small blocks of land?

Table 4.2: Vegetable production and gross value per hectare, compared with other forms of farming in Victoria (1970)

Land use	Annual production per hectare	Gross value per hectare
Market gardening	40 tonnes	$4,500
Dairying (for milk)	5,930 litres	$520
Beef cattle	340 kg of beef	$215
Wheat	1,090 kg	$90
Sheep for wool:		
High rainfall area	18 kg of fleece	$15.00
Sheep-wheat zone	4.5 kg of fleece	$3.75
Pastoral zone	2.25 kg of fleece	$1.90

Source: B.A.E. Reports

Conclusions

We have seen that market gardening is a very busy and complex form of agricultural activity. Because market gardens need to be near their urban market, they face competition for land from urban activities such as sewerage farms and golf courses. In the area of the Dingley sample farm, sand pits and suburban growth are also important competitors. Such competition has a major effect on vegetable growing. Farms are small but intensively run: large amounts of labour, fertilisers and water are used, along with the staggered growth of up to three crops a year. As a response to this intensive activity, market gardens produce huge volumes of high-priced vegetables, allowing them to continue farming on the rural-urban fringe.

FURTHER ACTIVITIES

Now that you have read and considered one market garden close to a large urban area, you should be able to collect information to allow you to compare this with a market garden close to your school or home. It may be possible for the whole class to visit a local market garden. Alternatively, one member of the class could interview the farmer and then report back to the rest. Try to complete the following table:

	Dingley sample farm (complete the blanks)	Local market garden
Size of farm	9 hectares	
Is it all in one piece?	2	
Distance from the market	23 km	
Nature of the countryside (hill, flat plain, flood plain)		
Crops grown		
Fertilisers used		
Cost of fertiliser per hectare		
Water supply amount		
Water supply cost		
Number of workers		
Equipment used		
Main problems facing the farmer	Increased costs—rates, labour, machinery	

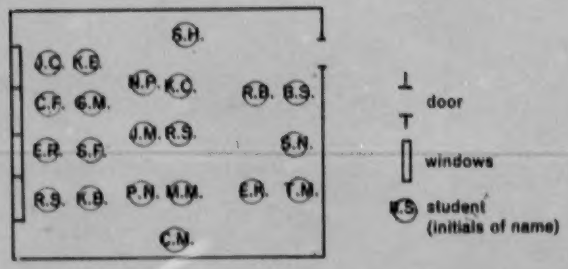
LOCATION STUDY

As you can see, geographers are very interested in trying to explain why things are where they are. Have you ever considered why you sit where you do in the classroom?

Why do people sit where they do in class?

This can be a fascinating study! What possible reasons can you suggest for the seating system in your classroom? Do people of about the same age (in years and months) sit together? Do people of about the same height sit together? Do people who support the same football team sit together? Do people whose homes are close together sit together in the classroom? Make a list of all your suggestions.

Record the location of each student in the room on a map. You may record the locations as shown here.


S.H.
J.C.
K.B.
N.P.
K.C.
R.B.
B.S.
C.F.
G.M.
J.M.
R.S.
S.N.
E.R.
S.F.
R.S.
K.B.
P.N.
M.M.
E.R.
T.M.
C.N.
door
windows
K.S. student (initials of name)

Scale: 1 cm to 5 paces

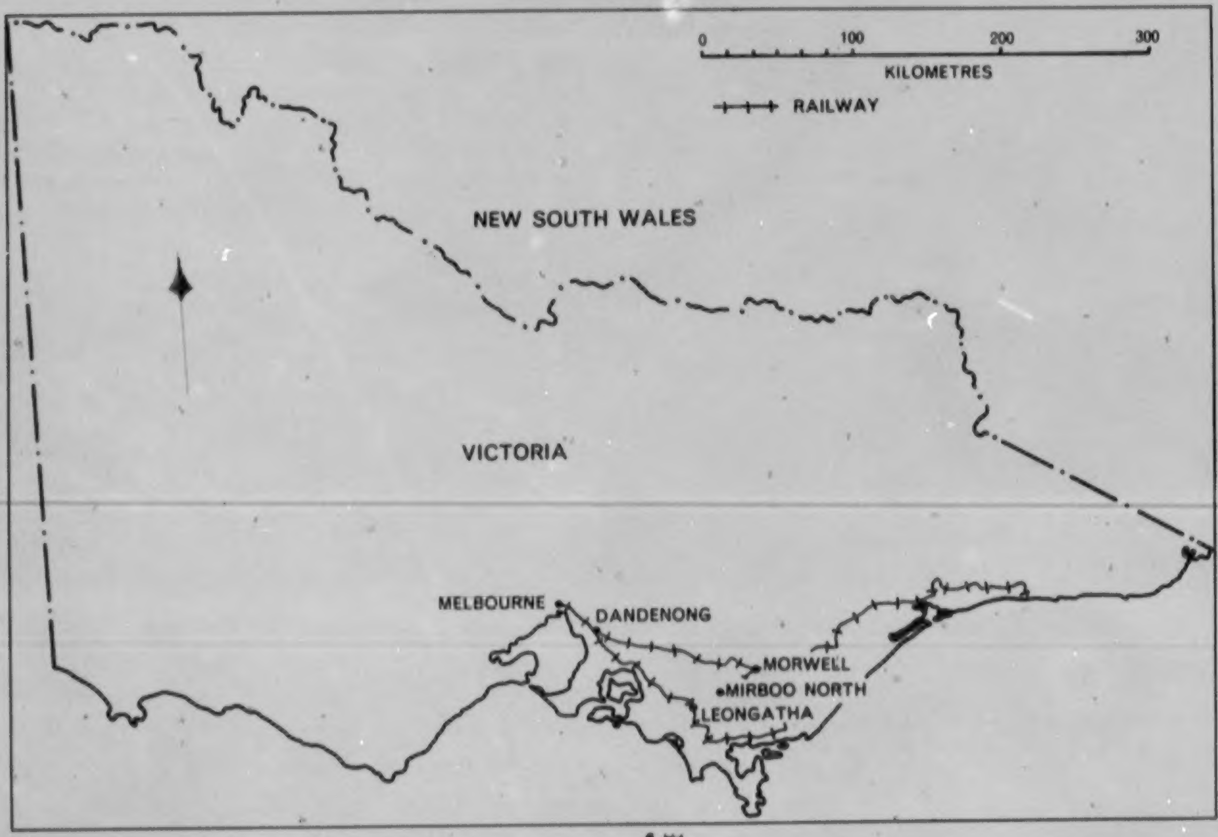
Study the guesses made to explain why students are distributed in this way. Convert these guesses into questions, and issue a questionnaire to all members of the class. The data can then be classified if this is needed, and then mapped. The data could also be recorded in graphs of various kinds. Can you see any regularities or patterns in the distribution of the data? For some classes, it has turned out that students of about the same age often do sit together. This could be an easy one to map if you used the same symbol to show people whose birthdays fall within a given three-month period.

You may like to extend your study and survey

- other classes in the same room
- other classes in other rooms
- your own class in other rooms.

Why don't some people associate — not only in classes but anywhere? Why do some people seem to avoid each other? Can you think of examples? Do you approve of such situations? Do you think that the seating arrangements in your class are the best possible, or the best for all situations?

Figure 5.1: Location map


0
100
200
300
KILOMETRES
RAILWAY
NEW SOUTH WALES
VICTORIA
MELBOURNE
DANDENONG
MORWELL
MIRBOO NORTH
LEONGATHA

5

A dairy farm

City areas change quite rapidly, as can be seen in study 14. Change also comes to rural areas, for farming is a complicated business involving the making of countless decisions. A good farmer, even if he is working on his own, will try to keep up with all the changes that occur which will affect his farming methods or the sale of his product. In the ten years of operating his present farm at Mardan in the Mirboo North area, Mr S. J. Hatherly has made many decisions regarding the use of his land and is succeeding in developing a successful farm. This study aims to give you some idea of the pressures on the dairy farmer and the way in which Mr Hatherly has responded to them during the past ten years.

Find Mirboo North on the location map (figure 5·1) and Mr Hatherly's farm on figures 5·2 and 5·3.

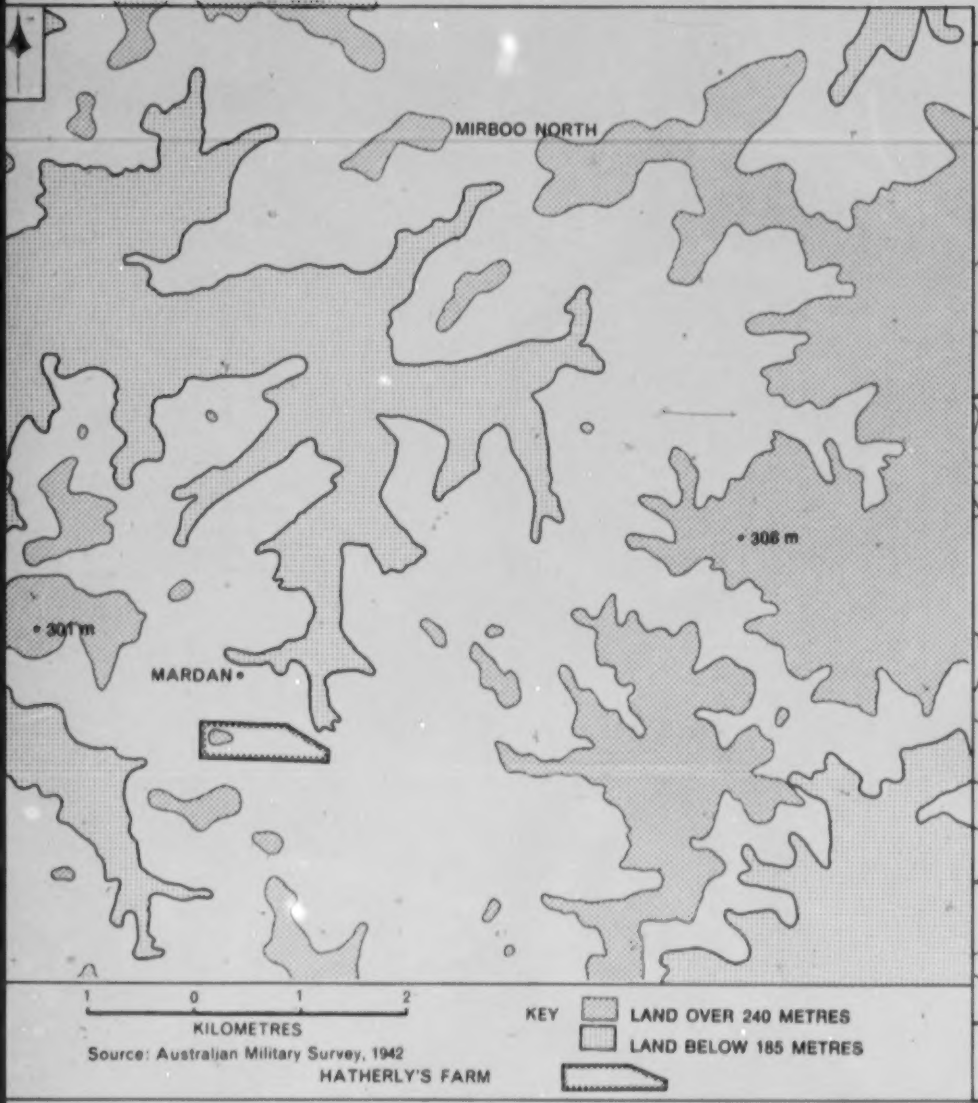
By almost any measure the South Gippsland area is one of Australia's leading dairying areas, yet beef, sheep, and potatoes are also produced in considerable amounts in this same area. Nearly all dairy farms are less than 120 hectares, but beef cattle and sheep farms are often considerably larger. The average size of an agricultural holding in West Gippsland is 82·5 hectares (1964-5). In 1943-4 the average size was 93·7 hectares. In this same period land has become more valuable and more intensively used. But it has not always been so. When Count Strzelecki travelled from Boolarra to Westernport Bay (72 km) in April 1840, his journey took 22 days. The whole region was one of Victoria's most densely forested areas. The forests were of mountain ash, blue gum, and blackwood trees, while the undergrowth was up to 6 metres high.

From 1877 people began to take out selections in the Mirboo North area at £1 per acre in 320-acre lots. Such a holding was allocated to Mr H. Kilday on 21 February 1889 in the area 7 km south of Mirboo North. A small part of his holding was reserved for a school, and an adjoining area was set aside for the township of Mardan. Although a primary school eventuated, the township of Mardan was never established. However, Mirboo North was proclaimed a town in 1885, the original settlers having walked from Morwell in 1878. Mirboo North became a railhead in 1886 and a butter factory was established in the early 1900s. However, transport was still slow and the roads were winding and poor. As transportation improved and the demands of the city and overseas market were realised, the butter factory and the town grew, and more dairy farms were established within range of the butter factory. The butter factory is still Mirboo North's only significant industry. The town has a stable population of about 800 but its people are being increasingly attracted to larger centres, particularly Morwell and Leongatha, for many goods and services.

From 1932 to 1958 the Kilday property was owned by a Mr Wilson, but in 1958 the Rural Finance and Settlement Commission purchased the holding and subdivided it into three. Through the Commission, Mr Hatherly gained Lot 3 of Wilson's Estate and named it 'Heathersett'. In 1958 this lot was valued at $16,180. The area was classed as semi-developed and was being used for rough grazing. The fences were old and broken-down. There were no farm roads, no buildings, no water supply, and poor pastures with a high percentage of weeds, particularly on the lower land.

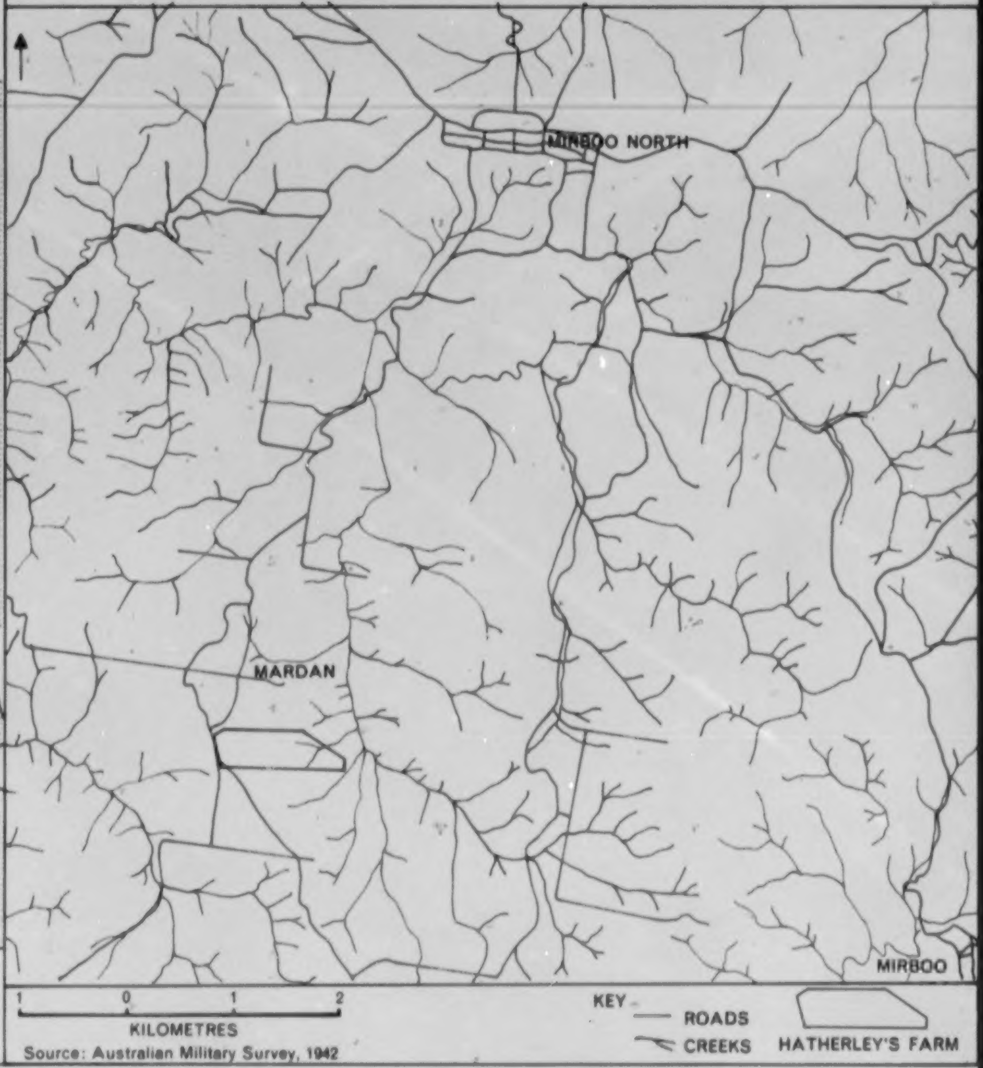
The farm is relatively small at 41 hectares. Immediately after taking over this land, Mr Hatherly and his son Bryan laid a water supply and later built new fences, a road and farm buildings, and planted trees as windbreaks. See figure 5·5. These improvements, together with careful pasture development and management, have been responsible for the stocking rate rising from 0·75 cattle per hectare in 1959 to 2·5 cattle per hectare in 1968. However, in May 1966 Mr Hatherly purchased a further 20 hectares of relatively underdeveloped land situated 5·5 km closer to Mirboo North. This new land, with the careful pasture improvement programme, has enabled Mr Hatherly to increase his stock numbers and bring in

48


MIRBOO NORTH
306 m
301 m
MARDAN
1 0 1 2
KILOMETRES
KEY
LAND OVER 240 METRES
LAND BELOW 185 METRES
HATHERLY'S FARM

Source: Australian Military Survey, 1942

Figure 5.2: Mirboo North area—relief


MIRBOO NORTH
MARDAN
MIRBOO
1 0 1 2
KILOMETRES
KEY
ROADS
CREEKS
HATHERLEY'S FARM

Source: Australian Military Survey, 1942

Figure 5.3: Mirboo North area—roads and creeks

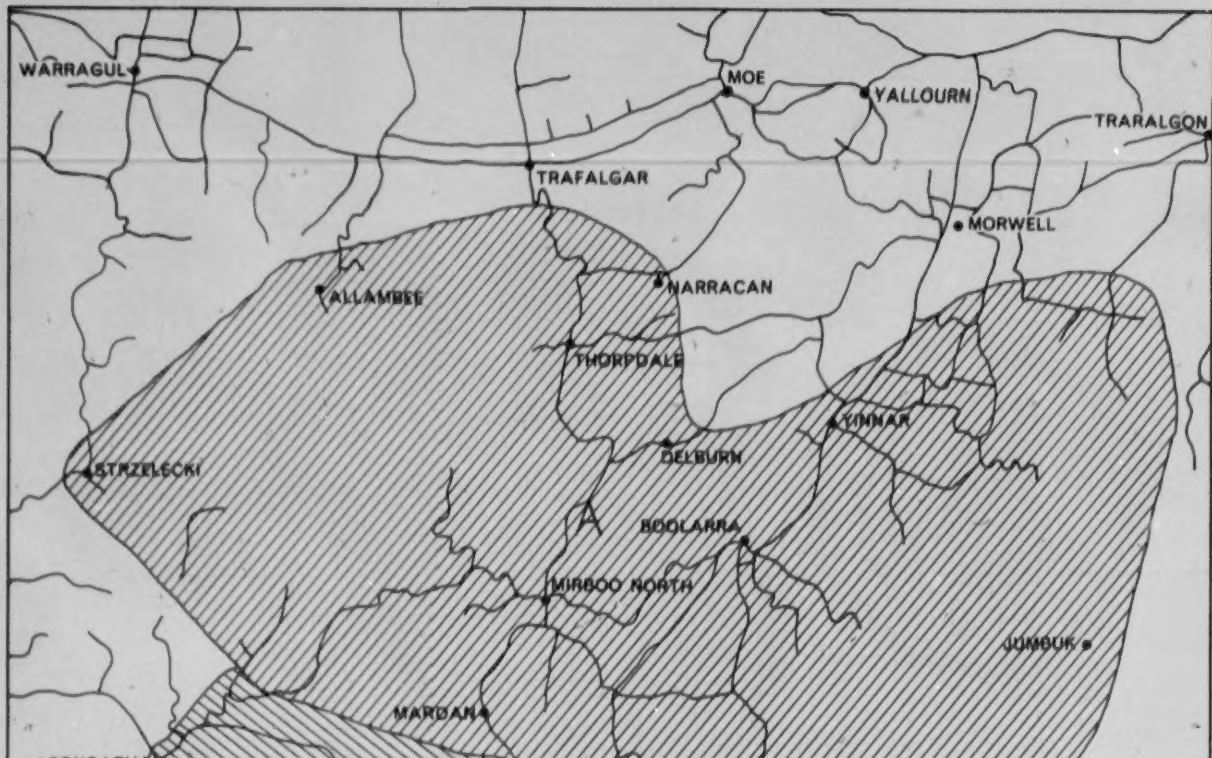

WARRAGUL
MOE
YALLOURN
TRARALGON
TRAFALGAR
MORWELL
NARRACAN
ALLAMBEE
THORPDALE
YINNAR
DELBURN
STRZELECKI
A
BOOLARRA
MIRBOO NORTH
JUMBUK
MARDAN
LEONGATHA
DUMBALK
B
MEENIYAN
FOSTER
WELSHPOOL
FISH CREEK
TARAWIN LOWER
KEY
SEALED ROAD
BOUNDARY OF SUPPLY AREA
OCEAN
N
3 0 3 6 9 12 15
KILOMETRES

Figure 5.4: Mirboo North butter factory—milk supply area

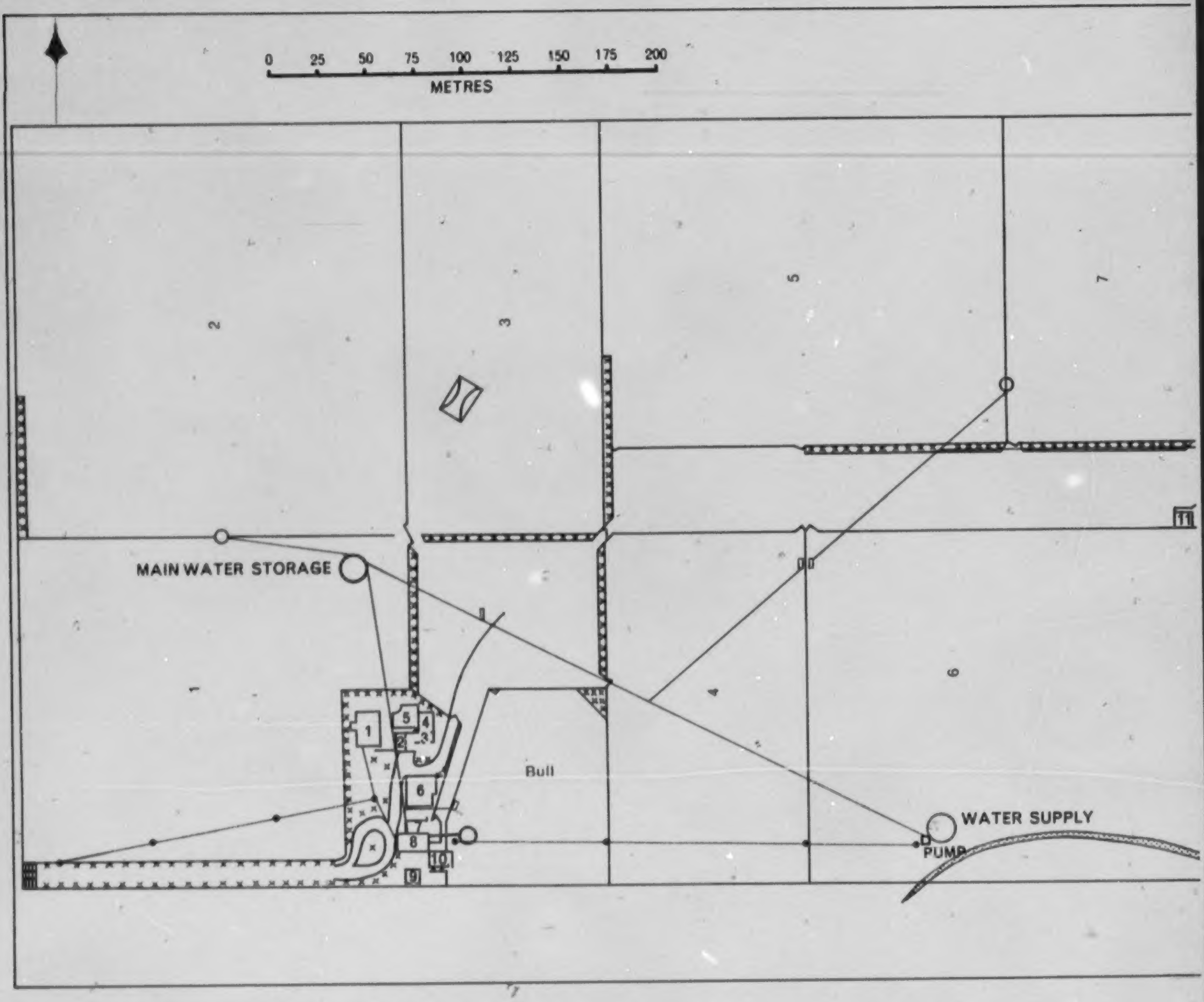


Figure 5.5: 'Heathersett', Lot 3, Wilson's Estate

sufficient income to support his wife and his sons — Chris, a student at Mirboo North high school, and Bryan, aged 20, who is fully employed on the farm. The new farm is used as a rest paddock and as a grazing paddock for dry stock and heifers.

Suggest reasons for this area being one of the last areas of Victoria to be settled.

Refer to figures 5·2 and 5·3. Using the photographs throughout this topic and the relief map, describe the relief of the Mirboo North area. What effect has the relief had on road and drainage patterns?

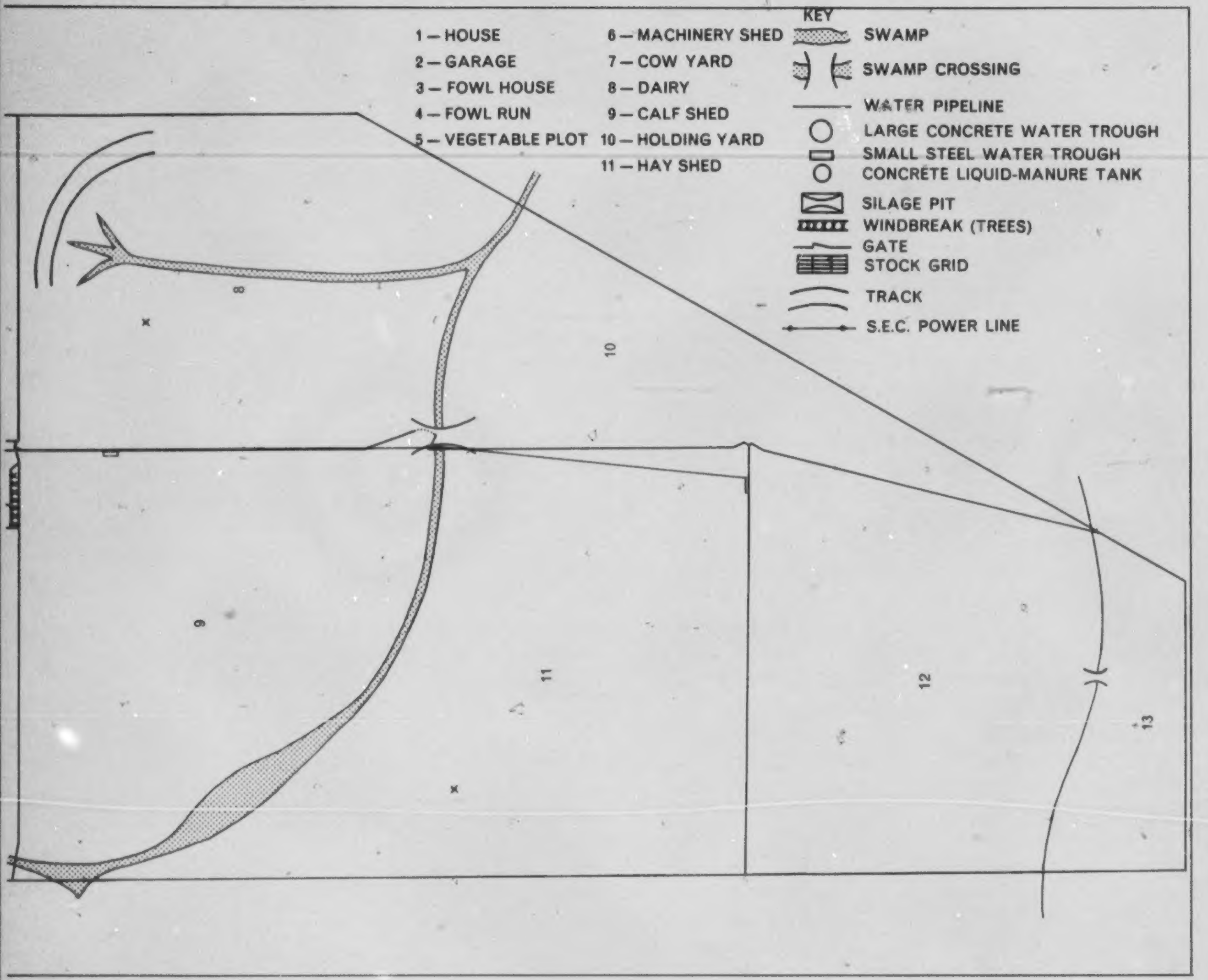
Why was land set aside for a town at Mardan and for several other towns approximately the same distance from Mirboo North? Why did Mardan not become a town? Why is Mirboo North now declining — at least relatively — in relation to larger centres? Do you know of towns in your area that, like Mardan, did not grow? Are there towns in your area that are declining slowly?

Why was it necessary for Mr Hatherly to clear and improve the land instead of using it in the same way as previous owners?

Without necessarily referring to this area, suggest reasons why farms vary in size.

To market, to market!

Heathersett contributes milk to the Mirboo North


1 — HOUSE
2 — GARAGE
3 — FOWL HOUSE
4 — FOWL RUN
5 — VEGETABLE PLOT
6 — MACHINERY SHED
7 — COW YARD
8 — DAIRY
9 — CALF SHED
10 — HOLDING YARD
11 — HAY SHED
KEY
SWAMP
SWAMP CROSSING
WATER PIPELINE
LARGE CONCRETE WATER TROUGH
SMALL STEEL WATER TROUGH
CONCRETE LIQUID-MANURE TANK
SILAGE PIT
WINDBREAK (TREES)
GATE
STOCK GRID
TRACK
S.E.C. POWER LINE
8
10
9
11
12
13

butter factory. This factory, which takes as much milk as Mr Hatherly's herd can produce, is one of many owned by the Murray-Goulburn Cooperative Company. The company purchased the factory in 1966. Most of its production is sold to Japan, Singapore, Malaysia, Hong Kong and the United Kingdom. The United Kingdom is a regular but declining customer for Australian dairy produce and the competition for Asian markets is intense. The Commonwealth government subsidises the Australian dairy industry by $27,000,000 annually. This grant enables the dairy farmer to export dairy products and still make a profit.

Figure 5·4 shows the area contributing to Mirboo North butter factory. Area B contributes to a depot at Dumbalk where a butter factory operated until it was taken over and closed by the Murray-Goulburn company. The company believes that the one larger factory is not as expensive to operate as two smaller factories despite the extra transport costs involved. Milk is transported daily to Mirboo North from Dumbalk, but these costs are offset by the enlarged scale of operations at Mirboo North, and the overall employment of less labour. An important innovation has been the continuous butter-making machines which can handle 680 kg of cream per hour and convert cream to butter in 2½

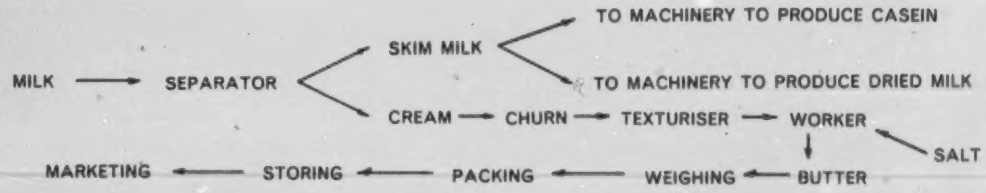


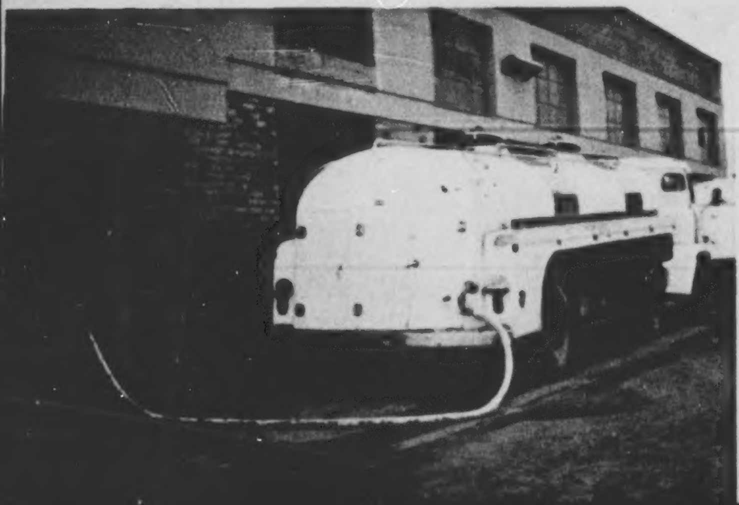
Figure 5.6: Processes in butter production. On arrival at the factory, milk goes through a separator which extracts the cream used to produce butter. The rest is fed into machinery which produces casein or machinery for dried milk

minutes. The older churns were operated for two hours before any butter was produced, and then the churns had to be emptied, largely by hand, and prepared again. This method of making butter produced 90 boxes every two hours; the new machines produce 130 boxes in two hours. Although butter is the main product from the factory, dried milk and casein are also produced to ensure that there is no waste of milk and to provide alternative sources of income if one of the products faces market difficulties. (See figure 5·6.) Find out what casein is used for.

In the first year of operating his new farm, Mr Hatherly sent milk in cans to the Dumbalk factory, but he soon developed a road on the farm and the bulk milk tanker now collects milk for the Mirboo North factory (figure 5·7). The tanker driver takes a sample of the milk collected at each farm. This sample is later tested for butterfat content and this determines the farmer's income.

Milk collection costs are important to the company, especially since the tankers, whose capacity varies from 5,500 to 10,000 litres, are expensive to run. Tankers run at about 1 km/litre on petrol and 4 km/litre on diesel fuel. What is the average fuel consumption of your father's or friend's car? All tankers rapidly wear tyres. Because of such operating costs, the more milk picked up per kilometre travelled, the better for the factory. The most favourable situation for the factory would be for the area about the factory to be entirely devoted to dairying, for all farms to be highly productive throughout the year, and for all farm dairies to be located on a few roads directly linked to the factory. Thus, the tanker would be filled on each trip and yet travel a relatively short distance. But ideal conditions do not exist for the factory or for the farmer. Dairying is certainly not the only profitable type of farming that is, or could be, conducted in the area, and many farmers have therefore chosen not to be dairy farmers. Furthermore, as we shall point out later, there are numerous difficulties involved in producing milk all year round. Finally, although roads are being continually improved, they still constitute a major problem for the councils of the area.

Figure 5.7: Milk tanker unloading at Mirboo North butter factory



Study figures 5·3 and 5·4. Compare the pattern and density of roads in this area to the pattern and density (as shown in your atlas) in the Wimmera wheat area of Victoria, or any other wheat growing area you know.

Why are small factories like Dumbalk being closed down?

What decides how far a tanker travels to pick up milk?

What do you think are the advantages in the bulk handling of milk over the former system of handling milk in cans?

Climate

Dairying is possible under quite different climatic conditions, and is quite popular in mid-latitudes. Study a map showing the distribution of dairy cattle in Australia (*Jacaranda Atlas*, p. 18). Describe their distribution in relation to temperature, rainfall, and population distribution.

Refer to tables 5·1 and 5·2. There is little pasture growth when the temperature is below 10°C. In which months is there little growth due to the temperature?

A rough indication of the months in which pasture growth occurs is provided by a formula: if precipitation exceeds evaporation by greater than one-third, then growth may occur. Compare tables 5·2 and 5·3. Which months for Mirboo North pass

Table 5.1: Mirboo North — temperature (°C)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
18.1	18.7	17.2	14.1	11.8	9.4	8.9	9.8	11.4	13.1	14.9	16.9	13.7

Table 5.2: Mirboo North — rainfall (millimetres)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
53	71	76	89	107	104	99	112	99	99	91	86	1,086

Table 5.3: Evaporation in millimetres at Maryvale (near Morwell, 38° 11′ S, 146° 27′ E), 1954-9 average

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
150	112	94	66	51	36	33	43	56	81	97	124	943

Source: 'Evaporation in Australia', C.E. Hounam (Bureau of Meteorology, Commonwealth of Australia, Bulletin No. 44, Melbourne, 1961)

Table 5.4: Mirboo North — rain days (days receiving more than 0.25 mm)

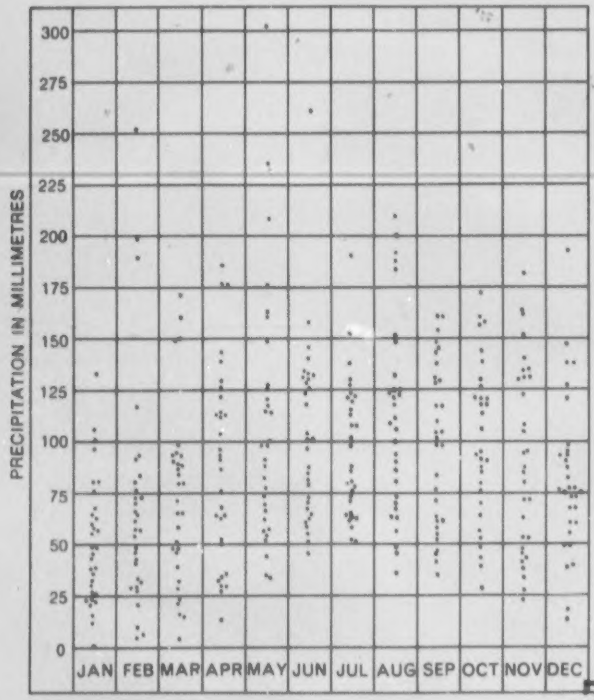
Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
6	8	8	11	15	14	15	15	13	13	11	9	138

this level? In which months is pasture growth at a maximum? Why?

Refer to figure 5·8: this graph shows how rainfall has varied over a thirty-year period. What are the greatest and the least amounts of rain received in the months of July and December? Which month seems to be less reliable for its rainfall? In what ways do you think this affects the dairy farmer?

In what ways does the information in table 5·4 help you answer the previous problem?

Figure 5.8: Mirboo North—precipitation, 1938-68. Each dot represents the rainfall for that month for each of the thirty years



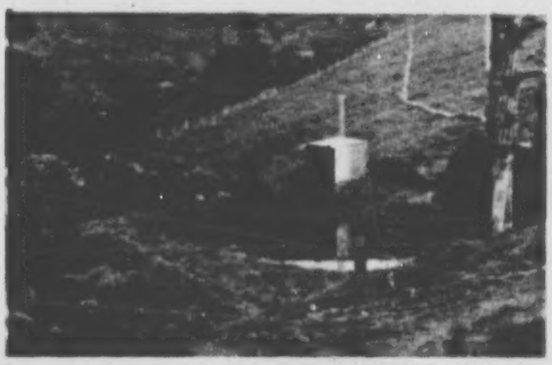


Figure 5.9: Spring-fed dam and pumphouse (see figure 5.5)

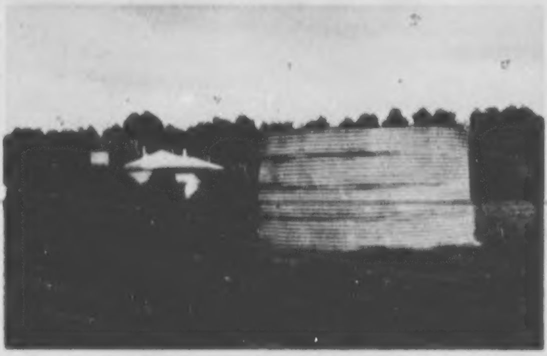


Figure 5.10: Main holding tank and farmhouse

Figure 5.11: A water trough

Water

Hatherly's farm has no irrigated land and so is classed as a dry farm. However, Mr Hatherly is keenly aware of the importance of a constant and sufficient water supply. The development of such a supply was Mr Hatherly's first concern on taking over the land in 1958. See figure 5·5.

In a few places the land is steep, but about 39 hectares can be driven over by tractor. This means that Mr Hatherly can use the tractor to spread fertiliser. Some farmers hire aircraft contractors to spread fertiliser. However, there are also few areas of flat land at Heathersett and the need for more land, particularly flat land, was one reason for the purchase of the new land, which is relatively flat and low lying. Unlike the higher slopes, such areas usually have new grass growth even in summer.

Water is supplied to each paddock from the spring-fed dam (figure 5·9). This dam has never been dry — even in the record drought of 1967 — and this is a considerable asset. Water is pumped to the main holding tank (36,000 litres capacity) located on the highest part of the farm (figure 5·10). From there, water flows to the troughs in all fields. A cow may drink 20-180 litres of water per day, depending on the climate, the weather, her size, the amount of milk being given, and the moisture content of her food. If the average water intake of a cow is 70 litres, then for horses it is 45 litres, pigs and sheep 7 litres each, and for poultry 28 litres per 100 per day. Thus the water needs of the dairy cow are relatively high. A further 1,270 litres per day are used on the farm in washing and cleaning the dairy after milking. Water troughs in each paddock save considerable labour and reduce the likelihood of disease (figure 5·11).

The spring that supplies the dam also brings a problem — the swamp area (figure 5·12). In summer the cows enjoy grazing in this area. Water grass makes the best pasture for the marshy conditions. Nearly all rushes have been removed from the lowland areas, and engineers have considered the area not worth draining in view of the great difficulties involved and the fact that it is not a serious disadvantage to the farm.

Why is a combination of flat and hilly land an advantage for a dairy farm in this area?

What is a spring? How is it formed?

Pasture — a basic resource

A well-sown pasture lasts 20-30 years, but on this farm a major problem is still the control of bracken fern. In 1958 the area occupied by paddocks 8, 9, 10 and 12 was infested with bracken fern, blackberry, rushes and scrub. Pastures are regularly sprayed to eliminate weeds. All land has been sown with a carefully selected mixture of rye, clover and cocksfoot grasses. A pasture may be regarded as a *plant community*. Different grasses have different leaf characteristics and positions in relation to the ground. Ryegrass, for example, stands rather erect and allows more light to pass into the community than do stands of clover. Clover has leaves set mainly in a horizontal manner so that if clover dominates, other grasses may die, or not grow, because of the overshading. Thus the best pasture consists of several types of grasses. The following will give you some idea of the variety of grasses Mr Hatherly uses per hectare (the list is not complete).

- 9 kg of Victorian perennial rye — a persistent and productive grass under heavy grazing. It grows mainly in spring but persists in the summer. But a pasture consisting wholly of perennial rye is not desirable because, in the absence of clover, the grass becomes yellowish and unproductive during the winter. Clover supplies valuable soil nitrogen.
- 3·5 kg cocksfoot—a deep-rooted grass. Although cocksfoot grows poorly in winter, its spring growth is late and extends into autumn if water is available. Because of this long growing season it is very useful, especially as it combines well with rye and clover.
- 2·25 kg of New Zealand cow grass (red clover)—useful for hay.
- 1·1 kg Mt Barker subterranean clover — a mid-late clover providing good summer feed.
- 1·1 kg Yarloop subterranean clover — a clover which grows rapidly with the onset of autumn rains and produces even in very wet conditions.

A farmer must decide how many stock to carry on his land. What is the importance of seasonal variation in pasture growth? What other factors would you consider in deciding stock numbers?

Making hay while the sun shines

In spring there is an abundance of grass; in autumn and winter, a shortage. Thus much grass is cut in spring and early summer and stored as hay or silage. But this is also the time of peak milk production, and so the Hatherlys are very busy. Some fodder crops (oats, turnips, rape, millet) were grown before 1965, but Mr Hatherly now considers that hay and silage making takes the land out of use for less time than do fodder crops and that quality pasture is of greater value than fodder crops.

Silage is merely preserved grass. It is made by

Table 5.5: Reserves of hay and silage (hay in bales; silage in tonnes)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Hay	2,500	2,500	2,500	2,500	2,300	1,800	500	500	500	—	—	2,500
Silage	40	20	20	—	—	—	—	—	—	—	50	50

cutting the grass and then stacking and compressing it to exclude air. Sugars in the plant juices are converted by bacteria to lactic acid. It is this acid that preserves the grass as silage.

Mr Hatherly formerly made silage by using a mower and a buckrake. This was cheap but was a time-consuming, two-stage operation — first mowing the grass, and then collecting the grass with the buckrake and depositing it in the silage pit (figure 5·13). Why must the silage pit be well drained? Mr Hatherly now employs a contractor to make silage with a forage harvester. This machine is expensive but completes the mowing and gathering of grass in one operation. It is also more efficient since it leaves little waste. The use of a contractor frees Mr Hatherly for other work at this very busy time. In 1968, 7 hectares were cut for silage in 10½ hours by the contractor at a cost of $22 per hour. With a mower and rake, Mr Hatherly and his son would have taken two weeks to complete this work.

Hay is lighter than silage, and it is easier to handle bales of hay than to fork silage. Hay stores well even if of poor quality, and the whole process is simple. Each year from about early October, some 8 hectares of Heathersett and 6 hectares of the new land are reserved for hay. Hay must be cut before the grass goes to seed. Mr Hatherly cuts the grass with the farm's mower, and 2-3 days later a contractor rakes the grass into rows. Some 24-48 hours later, the contractor bales the hay and stacks it in the shed (figure 5·14). Fine weather is essential to dry the grass, for wet hay rots. Hay is fed to the cows at the rate of one bale to 5 cows each morning from May to September (see table 5·5). Why is hay fed to cattle in the months indicated?

Compare and contrast the advantages and disadvantages of hay and silage.

Study figures 5·5 and 5·14. In what direction was the camera facing when the photograph was taken? (Note that the shed is enclosed on the far side and the right-hand side.) What month might it be?

Pasture management

Uncontrolled grazing means that cows eat only the best in spring when there is a pasture surplus. But feed not eaten in spring is not so palatable or productive by February and yet must be eaten. Production of milk declines. The farmer seeks a balanced situation, and this is one reason why there are a large number of paddocks (see figure 5·5). Each paddock is used in turn.

Strip-grazing is also employed as a means of controlling pastures. Strip-grazing involves confining the herd to a small area through the use of a mildly electrified wire. The wire is shifted about 20 metres each day. The cows thus eat out a small area thoroughly, rather than wasting energy in walking about and eating the choicest grasses. The area to be strip-grazed is top-dressed with 130 kilograms of urea per hectare in May. This fertiliser, rich in nitrogen, stimulates pasture growth in preparation for strip-grazing from mid-June. Paddocks 2, 3 and 4 are regularly strip-grazed.

The new land also helps in effective pasture management. In autumn all animals are grazed on this land and soon eat it out. They are then fed on hay previously cut from this same land. The cattle then return to fresh pastures at Heathersett as calving time approaches. Thus the cows are on this land, most distant from the farm, when they require the least attention.

However, farm management cannot overcome all problems. The record-breaking 1967 drought not only affected production in 1967 and early in 1968 but, because the cows calved while in poor condition, the 1968-9 production was also below expectation. Despite the 1967 drought, overall production rose. What reasons can you offer to account for this?

Soil

Because pastures are intensively used, they have to be well fertilised. Each autumn the fields are harrowed to spread cow manure evenly over the pasture. This prevents clumpy growth and helps to fertilise the land. Paddocks close to the dairy are also fertilised with liquid manure. The dung in the dairy holding yard is watered to a liquid state after each milking (figure 5·15), and is stored in an underground pit. Figure 5·16 shows the manure spreader operating in paddock 3. The camera is facing WNW.

The whole farm is also artificially fertilised, but the requirements vary according to the soil

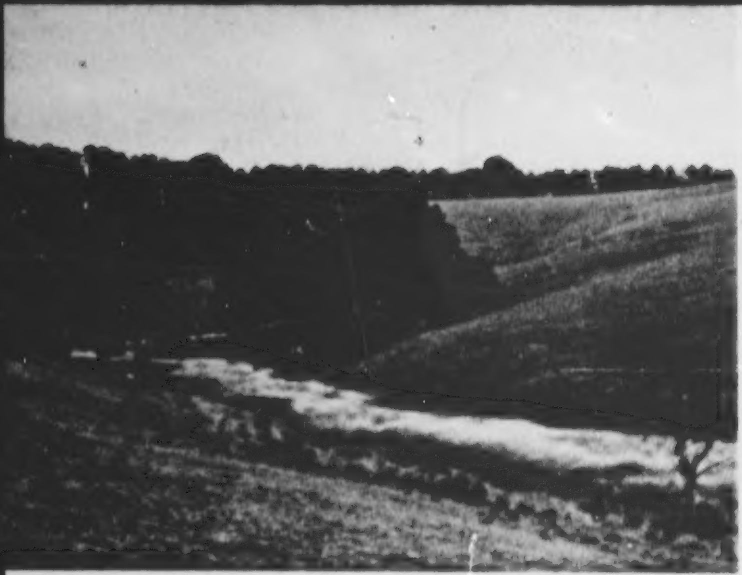


Figure 5.12: The swamp area

Figure 5.13: Empty silage pit

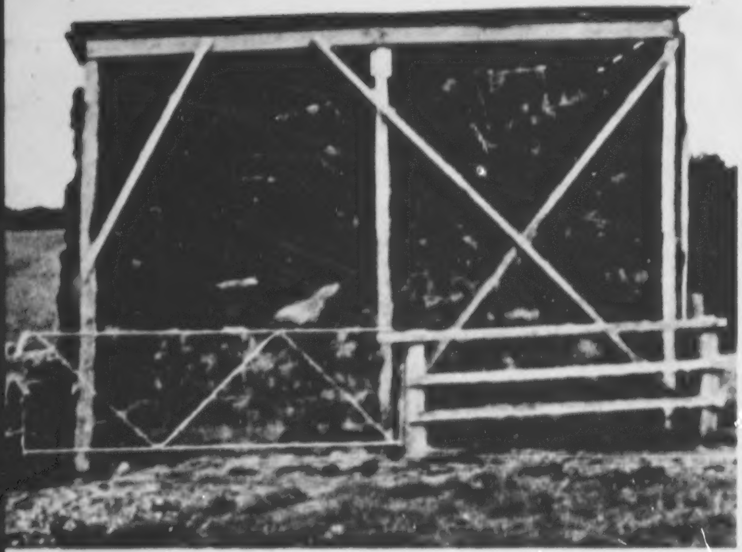


Figure 5.14: The hay shed

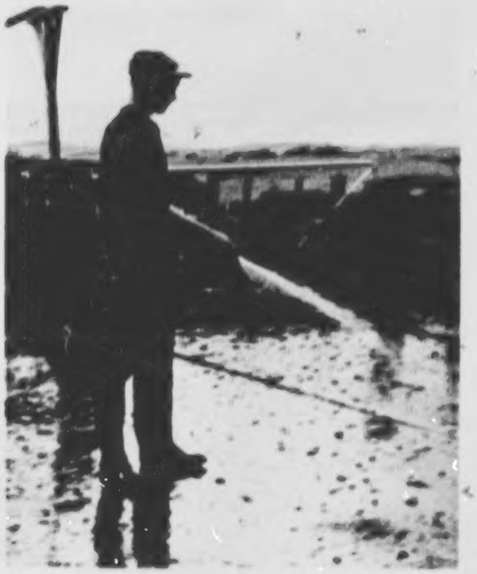


Figure 5.15: Bryan Hatherly hosing the holding yard

Figure 5.16: Manure spreader

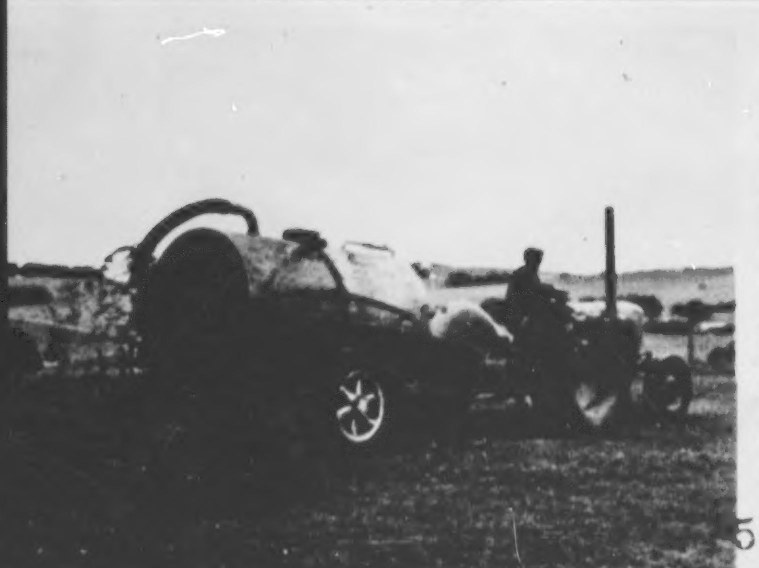
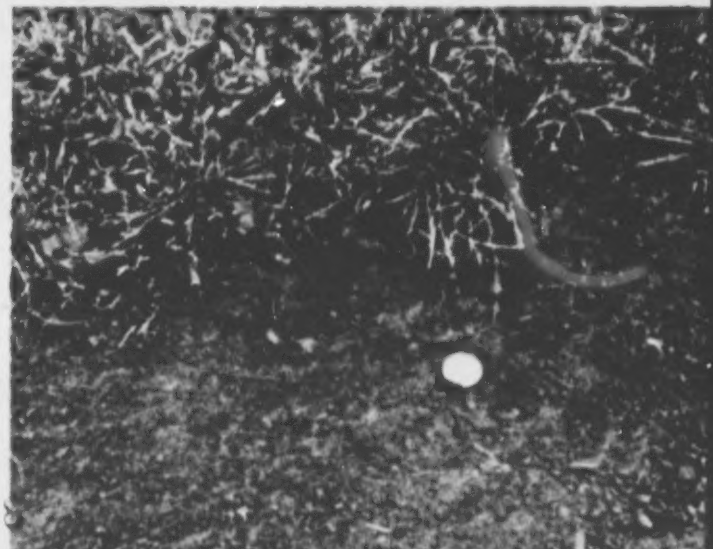


Figure 5.17: Red loam (scale indicated by 20c piece)



type and the use made of the land. Figures 5·17 and 5·18 show the two soil types occurring on Mr Hatherly's farm. The whole fertilisation programme is carefully planned to give maximum economic benefit, and each year fertiliser is applied at the rate of 250-580 kilograms per hectare. (See figures 5·19 and 5·20.) The fertiliser is usually a 3:1 mixture of superphosphate and potash. In 1968 Mr Hatherly fertilised his hay paddocks with extra fertiliser to replace losses due to the drought in 1967.

Why does the application of fertiliser vary from field to field, and from year to year?

Why is the liquid manure spread on fields close to the dairy?

Why are fields fertilised before winter or in early spring?

The stock

Dairy produce has a higher food value than that of any other farm animal, with the exception of pigs and poultry. It is naturally very important for the dairy farmer to have the best possible stock on his farm. In his first year, Mr Hatherly brought only the best cows from his former farm and the butterfat yield per cow was high. Table 5·6 shows total annual butterfat production from 1959 to 1967. Providing that a more normal rainfall is received in the next few years, Mr Hatherly expects the yield per cow to rise considerably.

Table 5.6: Annual butterfat production (kg) — milking season, May to May

1959-60	1960-1	1961-2	1962-3	1963-4	1964-5	1965-6	1966-7
4,362	4,147	5,184	5,906	6,885	6,223	6,613	6,581

The average herd of milkers for Mirboo Shire was 52 cows in 1966. Mr Hatherly then had a herd of 72 cows, of which 3 were Jersey-Friesian cross and the rest Jersey cows (see figure 5·21). The Jersey breed of cow yields milk with a higher butterfat content, but the Friesian yields more actual milk.

Each month, milk from each cow is tested for butterfat content. A record of these tests makes it possible for the farmer to remove low producers from the herd and retain the calves of high-producing cows. The inefficient or 'culled' cows are sold for meat and are known as 'choppers'. Choppers are usually sold for about $70 each. Each year about one-fifth of the milking herd is replaced in this way.

Herd quality is also raised by the use of high-quality bulls. The farm has three bulls, but artificial insemination is also employed. This costs

Figure 5.18: Yellow-grey earth

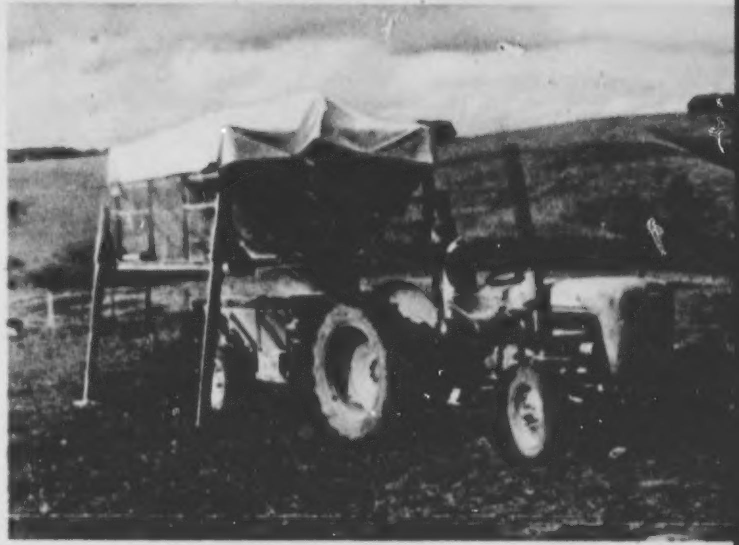


Figure 5.19: Loading the fertiliser spreader. The supplier of the fertiliser places the bin where it is required. This one is in paddock 12 with the camera facing SE

Figure 5.20: Fertiliser and seed dropper. The photograph was taken in paddock 6 (note hay shed in background)

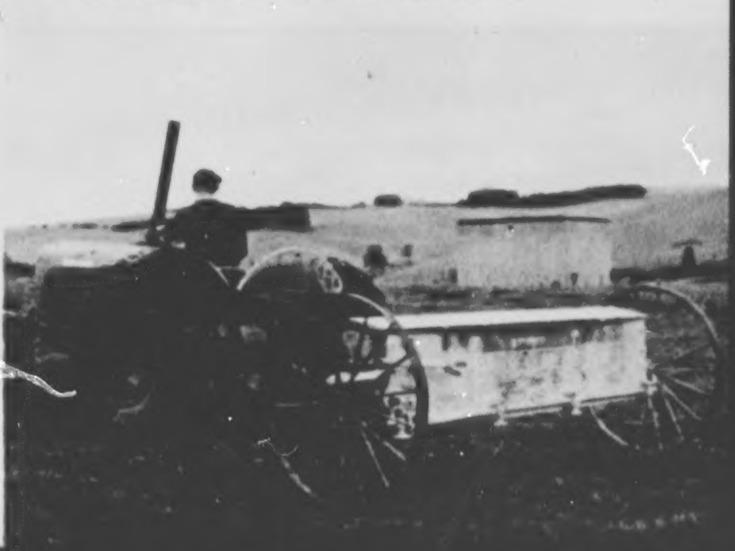


Table 5·7: Calves born in 1968

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
—	—	—	—	—	36	26	11	3	—	—	—	76

$3 per cow, but the expense is justified by the access to first-class bulls, the saving of time, and prevention of disease in the herd. A cow must calve each year to go on producing milk. Early in 1968 the herd consisted of 80 cows, but 4 were sold in January. Thus, 76 cows calved in 1968 (table 5·7). One calf died and eight late-born calves were reared by four of the least productive cows (sold as choppers early in 1969). Such animals require much less attention than the other calves which are hand fed, and so they are kept in paddocks 11, 12 and 13. Thus from about mid-1968, 72 cows were being milked.

Even though each cow calves each year, not all calves are retained on the farm. Half the calves are normally bull calves; they are sold at about three weeks of age for $5-$6 each. Some calves are sold at twelve months for about $40 each, while the rest join the herd at the second year, or are sold as 'springing heifers' (yearlings) for about $100 each.

If you visited a dairy farm near a large city, what sort of cow would you expect to find — a Jersey or a Friesian? Why?

Except in areas supplying fresh milk to urban markets, cows in Australia are generally valued according to their production of butterfat rather than their production in litres of milk. Why?

Why does the farmer arrange for the cows to calve before spring? What problems is this likely to involve? (See table 5·1.)

Refer to table 5·8. In which month is yield per cow generally highest? Why do you think production per cow varies from year to year? Why is production very low in March and April 1967?

Compare tables 5·8 and 5·9. Can you see any link between monthly rainfall and butterfat yield per cow per month?

Caring for calves

All animals need to be well cared for, but calves demand the most attention. Calves are reared from birth on a milk mixture. After two weeks they are also fed on a mixture of calf pellets and crushed oats. These calves are housed in the calf shed adjoining the dairy and are fed twice daily. As they get older, the calves are housed in the shed only at night, unless it is a cold day.

At about three months, some calves are placed in paddock 1 while the rest are placed in the bull paddock. The calves are then fed once per day and weaned 2-3 weeks later. Later the heifers are taken to the new land and run with the older stock.

Milking

Milk production is affected by the breed, age, feed, availability of water, and care given to the cow. The actual amount given on any one day may vary considerably. Milk yield may decrease 90 litres for the herd on a cold day. Windbreaks are essential to protect stock from the cold westerly wind. Can you identify windbreaks in the photographs?

Seasonal peak production is in October, and the farm's 1,000 litre vat is then full every day. At this time the Mirboo North factory handles some 320,000 litres per day. By May, the factory processes only a few thousand litres per day. Cows are not milked throughout the year. A dry period of 1-2 months per year is sound farming, for when the cow comes into production again, she produces considerably more than if milked continually. The cows are thus 'dried off' about April-May each year. May is thus a time of relative rest for Mr Hatherly and Bryan. Table 5·10 outlines their work routine on sample days, and table 5·11 their work year.

The butter factory pays higher prices to farmers if they contract to supply a certain amount of milk throughout the year, including the normal dry period. Such a farmer has to divide the herd into two groups with each group calving at different times. It also means that there is no holiday at all for the dairy farmer. Mr Hatherly is not on 'contract' milk, and looks forward to about six weeks respite from milking each May.

The farm has a six-unit milking machine, and each cow is milked twice daily for 4-5 minutes. It is important that the cow be well milked since the richest milk is that from the latter part of the milking. The dairy is the hub of the farm and efficiency here is important. The milking machines are electrically driven pulsators which take the milk from the cow and pump it through a long pipe to the cooling room. Here the milk flows across metal coils through which cool water flows. The cooled milk then runs into the bulk milk vat. (See figures 5·22 and 5·23.) From the vat the milk is taken by the tanker to the factory for processing.

Cleanliness is vital throughout the milking. Each cow is inspected for cuts, scratches or ailments,

Table 5.8: Average butterfat yield per cow per month (kg)

Year	No. of Cows	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1959-60	29	—	—	1.22	11.34	20.96	26.31	24.18	21.02	15.46	10.37	10.32	8.35
1964-5	69	—	1.03	9.62	14.11	16.28	16.92	16.23	15.70	10.04	6.48	5.47	1.28
1966-7	72	—	0.69	7.76	12.88	13.70	14.06	13.11	12.52	12.27	6.50	0.53	—

Table 5.9: Monthly rainfall (millimetres), May 1959-April 1967

Year	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
1959-60	59	105	51	126	163	92	45	76	50	71	29	132	999
1964-5	93	126	193	191	140	122	55	150	58	7	68	178	1,381
1966-7	90	60	132	67	118	120	86	139	60	29	90	33	1,024

Table 5·10: Work routine — sample days

MAY	JULY	NOVEMBER
6.30 a.m. rise	6.00 rise	5.30 rise
9.00 a.m. feed stock (hay)	6.30 milking	6.00 milk
12.30 p.m. repair and maintenance	7.15 feed calves; clean sheds	8.30 breakfast
1.30 p.m. lunch	7.45 feed stock (hay); shift electric fence	9.00 stock moved to feed
2.00 p.m. general work continues	8.30 breakfast	10.00 cut hay
6.45 p.m. dinner	9.00 farm work	1.30 lunch
	1.30 lunch	2.00 work on hay
	2.00 farm work	5.00 milking
	5.00 milking; check calving stock	6.45 dinner
	6.45 dinner	

Table 5·11: The work year

Activity	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Cattle	Latter part of lactation			All cows dried off and spelled on new land		All cows return CALVING	Bull calves sold			Peak milk production Cows joined		
Pasture	Silage fed to cows	Fields fertilised	Harrowing		Hay fed to stock in paddocks Urea on land to be strip-grazed	Strip-grazing		Harrowing	Fields fertilised	Fields for hay and silage closed	Make silage	Make hay
Other			Drenching of young stock Injections against fluke, blackleg, worms		Fencing and maintenance	Check for calving troubles (incl. milk fever)	Dehorning (6-8 wks after birth)	Prepare harvest equipment		Check for bloat		

and the udder is washed with an iodine solution prior to milking. After milking, the stainless steel equipment is cleaned and the yards hosed with a pressure hose (see figure 5·15).

A valuable business

The farm real-estate value is now about $30,000. Machinery and equipment are valued at $7,000,

Figure 5.21: The herd

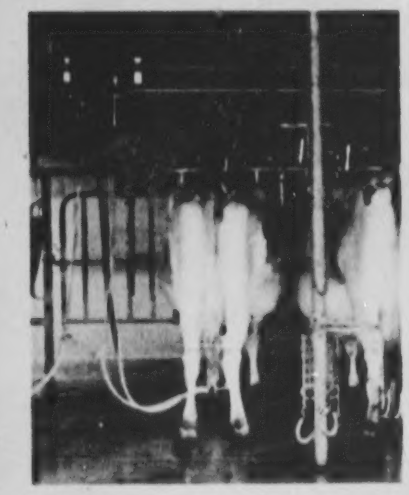


Figure 5.22: Milking

Figure 5.24: The dairy (right-hand side of photograph) and the equipment storage shed (left-hand side)

Figure 5.23: The milk vat

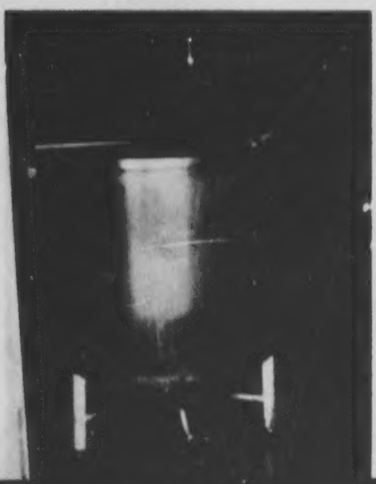


Figure 5.25: Looking west from paddock 12 (compare with figure 5.21)

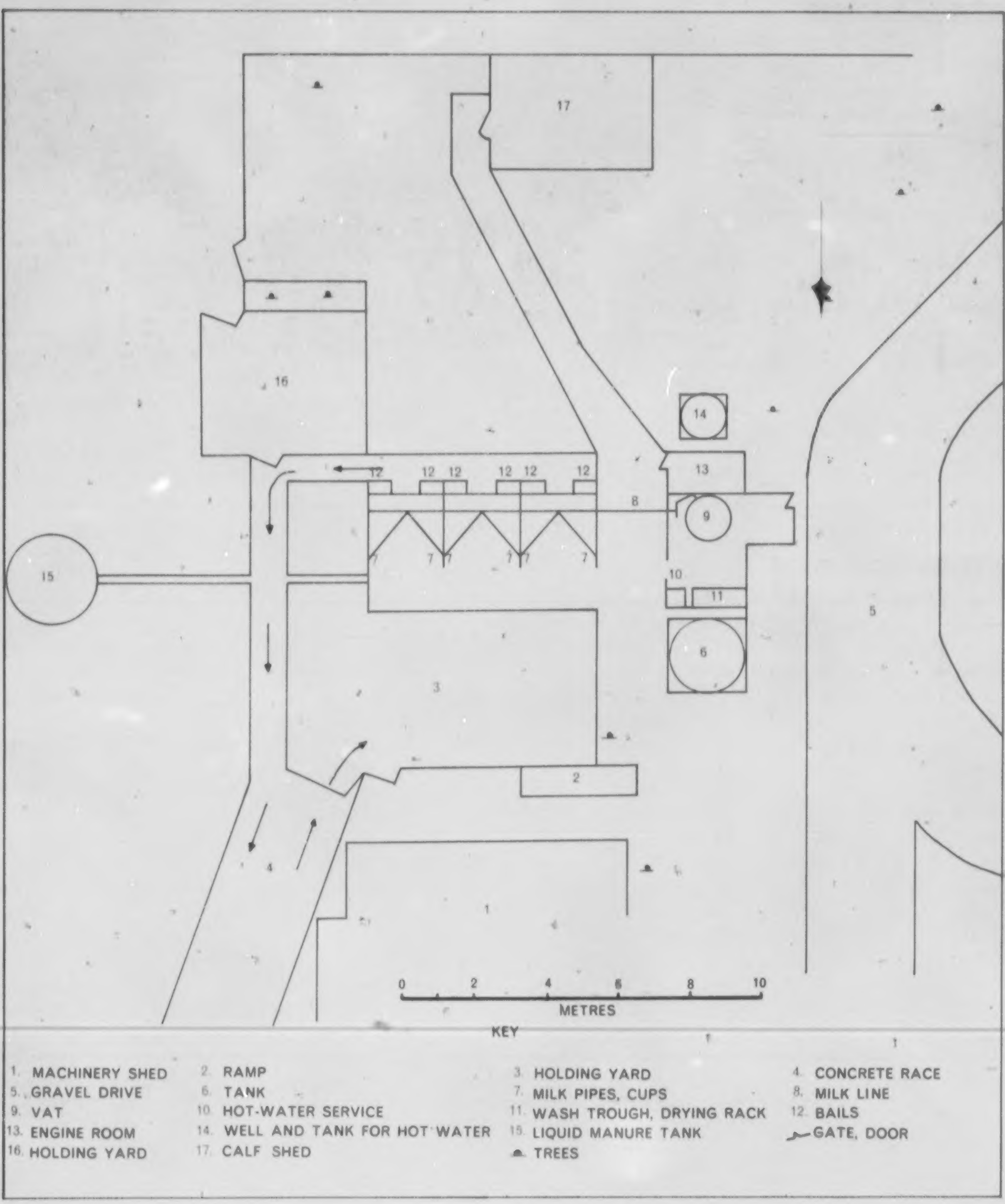

17
16
14
13
12
12
12
12
12
12
8
9
7
7
7
7
7
7
15
10
11
5
6
3
2
4
1
0
2
4
6
8
10
METRES
KEY
1. MACHINERY SHED
2. RAMP
3. HOLDING YARD
4. CONCRETE RACE
5. GRAVEL DRIVE
6. TANK
7. MILK PIPES, CUPS
8. MILK LINE
9. VAT
10. HOT-WATER SERVICE
11. WASH TROUGH, DRYING RACK
12. BAILS
13. ENGINE ROOM
14. WELL AND TANK FOR HOT WATER
15. LIQUID MANURE TANK
GATE, DOOR
16. HOLDING YARD
17. CALF SHED
TREES

Figure 5.26: The dairy area

livestock at $12,000, and feed and supplies at about $1,000. Equipment has been kept to a minimum, the farm not being large enough to justify the more expensive pieces of equipment or a herringbone type of milking shed. Nevertheless, the farm has:

1 x 6 unit milking plant ($4,000);
1 tractor;
1 fertiliser and seed dropper;
1 set of pasture harrows;
2 trailers — 1 small, 1 large (2 tonne);
1 set of disc cultivators;
1 mower;
1 buckrake;
1 liquid manure spreader.

It is most unwise for the farmer to leave such expensive machinery out in the weather. Thus Heathersett features several large sheds (see figure 5·24). The farm workshop is also in this same central area. The workshop means a saving in time and money since maintenance and repairs can be carried out on the farm by Mr Hatherly.

A central place

The farmstead may be considered as a central place; it is the management headquarters, the point from which Mr Hatherly and Bryan leave each morning to work on the farm. There are no other outlets from Heathersett (see figure 5·5), so that all goods leaving and entering the farm enter via the road and are distributed from this central place.

The farmstead is not, and need not be, central to the farm area to act as a central place. The farmstead is not located where Mr Hatherly preferred it to be located (see figure 5·5). A location more central to the farm area was preferred, but the access road could only be constructed along the southern margin of the farm, and a short road takes up less land and requires less maintenance than a longer one.

Refer to figure 5·27. What are the advantages and disadvantages, for both the farmer and the factory, of these locations of a farm on the farm land?

Refer to figure 5·5. Why are there windbreaks along the western margin of the paddocks? Why are there so many paddocks? (There are several reasons.) Why are the silage pit and hay shed not located near the farmstead?

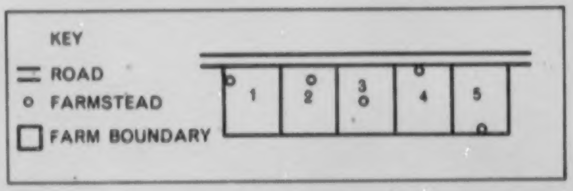


Figure 5.27

The farm plan does not show the new land, which is 5·5 km closer to Mirboo North. Why do you think Mr Hatherly bought more land? Why isn't this land used by milk cows during the milking season?

Dairy farming is demanding; the cow is constant in her demands, she must be milked twice every day — New Year's Day, Christmas Day, Easter . . . Mr Hatherly himself tires of this labour at times, but he and his son Bryan have had the satisfaction of seeing their efforts develop a piece of land into a valuable farm.

FURTHER ACTIVITIES

You may like to interview a dairy farmer you know, and see how he is trying to make his farm as efficient as possible. The following is a list of points raised in this study which would make suitable interview topics:

- location of farm in relation to nearest towns
- size and shape of the farm
- rainfall and soil problems
- pasture improvement
- pasture management
- stock management
- milking procedure
- method of marketing
- work calendar

In any case, listen to the tape recording provided with this project, based on a company dairy farm in Gippsland, Vic., and note the major differences between farm practices on this farm and those of Mr Hatherly. Dairy farming is indeed a complicated business! It is changing all the time.

6

The beef cattle industry

A REPORT ON MAN'S ATTEMPT TO CHANGE AND IMPROVE HIS FARMING

Where is Rockhampton? (See figure 6·1.) Locate it in your atlas. How far is it from your home town? How close to you is the nearest beef cattle farm in your state?

As a city with a population of over 40,000 people, Rockhampton claims to be the centre of the Australian beef export industry. Queensland has the highest numbers of beef cattle of any state in Australia (table 6·1); furthermore, the great proportion of cattle in Queensland lie within a 300 km radius of Rockhampton. Why should Queensland have so many more cattle than any other state? (You should consider the area and the location of each state when answering this question.)

Two main meatworks at Rockhampton process up to 1,600 beasts every day, most of the meat being exported (figure 6·2). Modern scientific methods of vacuum-chilling exported beef are far superior to freezing and there is little taste loss.

Table 6·1: Australian beef cattle numbers, 30 March 1969

Queensland	6.9 million
N.S.W.	3.9 million
Victoria	2.0 million
W.A.	1.4 million
Northern Territory	1.2 million
S.A.	0.6 million
Tasmania	0.3 million

Table 6.2: Main world exporters, beef and veal ('000 tonne), 1968

Argentina	565
Australia	403
New Zealand	185
Ireland	142

Table 6.3: Main world importers, beef and veal ('000 tonne), 1968

U.S.A.	678
U.K.	428
Italy	260
West Germany	192
Spain	111

Show the sets of figures in tables 6·2 and 6·3 in two different-coloured series of bar graphs. Australia is at a disadvantage as a beef exporter because shipping costs are more expensive. Even New Zealand can export beef to the United Kingdom or the United States for a lower price per kilogram of meat exported. Why?

Cattle are brought in for slaughter at Rockhampton from as far away as the western extremities of Queensland. Herds are generally transported to railheads from where they are moved east to the coast for slaughtering.

Belmont: The National Cattle Breeding Station (CSIRO), Rockhampton

Belmont was purchased by the Australian Meat Board in 1952 to provide facilities for studies on the adaptation of cattle to a subtropical environment. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) occupied the property in March 1953, and soon after a research laboratory was established in Rockhampton.

Belmont is located about 30 km north of Rockhampton on the Fitzroy River. The property consists of approximately 3,600 hectares freehold, and has frontage on the Fitzroy River for 18 km (see figure 6·3). Measure the length and breadth of this farm at the widest points. Would you call this a large farm? Compare it with another that you know.

What indication is there on the map that the soils are likely to be valuable for crop or pasture production?

The farm buildings are centrally located in relation to the farm as a whole. Why is this important? (See page 56.)

The largest paddocks seem to be those furthest from the homestead, whereas the smallest are those closest. Can you think of any reason for this?

The mean annual rainfall for Rockhampton is 952 mm, but the mean rainfall for the Belmont station since its establishment has been 805 mm. Mean maximum and minimum temperatures are

Figure 6.1: View of Rockhampton and the Fitzroy River from Mt Archer

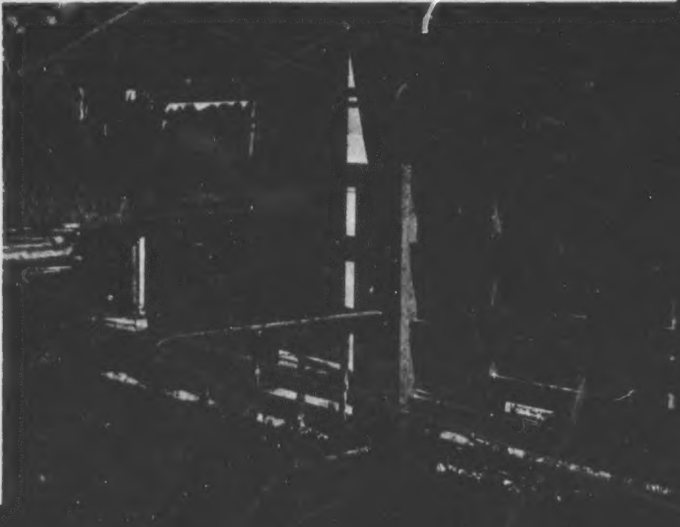
Figure 6.2: Lakes Creek meatworks, Rockhampton

Figure 6.4: Front gate, Belmont

Figure 6.5: Entomology buildings where tick research is carried out

Figure 6.6: Demonstrating his skill, a young jackaroo tests out a freshly broken-in horse

Figure 6.7: To what use do you think this building might be put?



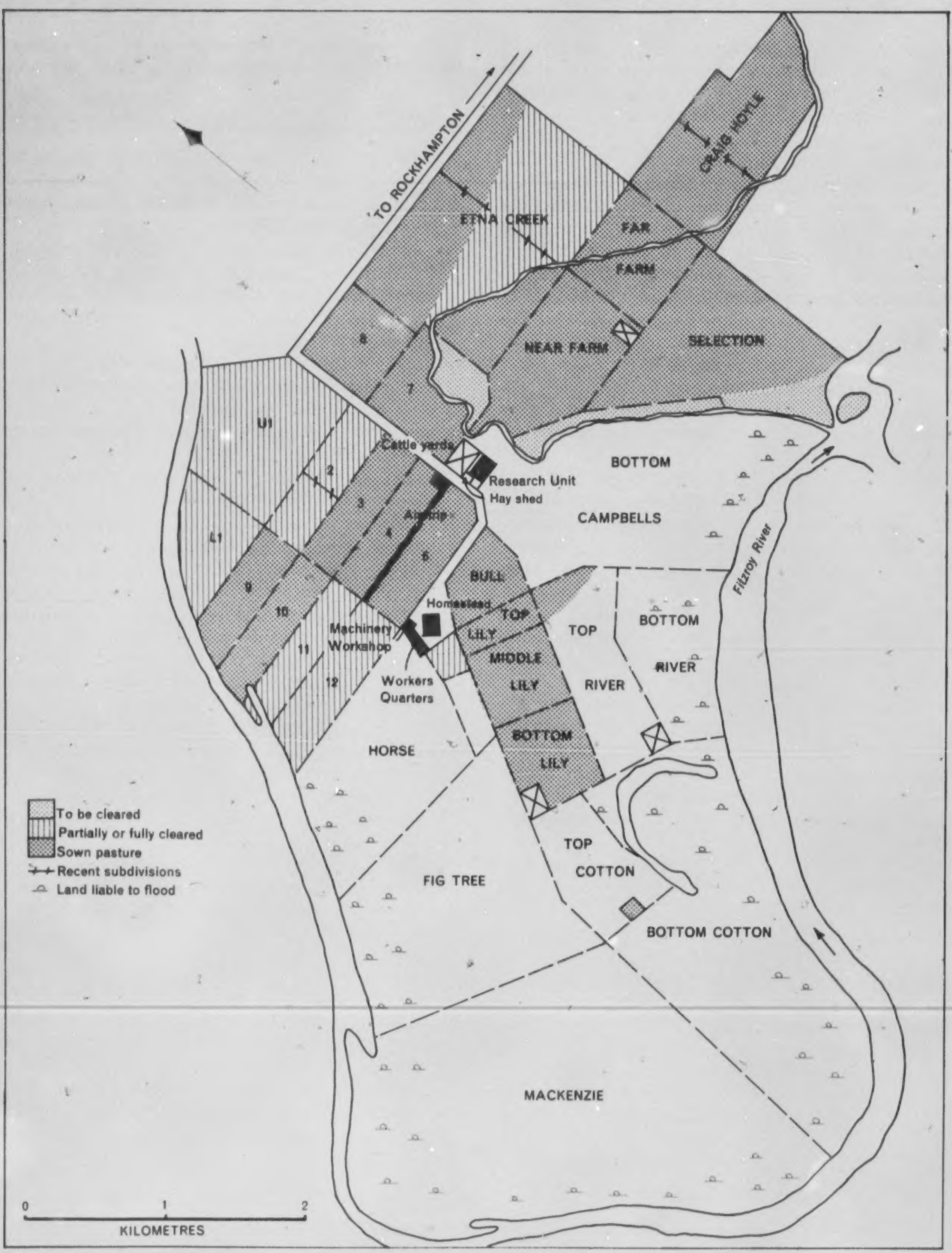

TO ROCKHAMPTON
ETNA CREEK
CRAIG HOYLE
FAR
FARM
8
7
NEAR FARM
SELECTION
U1
L1
Cattle yards
Research Unit
Hay shed
2
3
4
5
Airstrip
BOTTOM
CAMPBELLS
BULL
TOP
LILY
MIDDLE
LILY
BOTTOM
LILY
Homestead
Machinery
Workshop
Workers
Quarters
9
10
11
12
TOP
RIVER
BOTTOM
RIVER
Fitzroy River
HORSE
FIG TREE
TOP
COTTON
BOTTOM COTTON
MACKENZIE
To be cleared
Partially or fully cleared
Sown pasture
Recent subdivisions
Land liable to flood
0
1
2
KILOMETRES

Figure 6.3: Belmont farm plan

32°C and 21°C in January and 23°C and 11°C in July; nevertheless, the air remains fairly humid throughout the year. Probably the most outstanding features of the Rockhampton sub-tropical conditions are the high summer temperatures combined with very high humidity and high rainfall.

Look at the figures in table 6·4. Draw bar graphs to show the rainfall pattern for each of these stations. In what ways does the monthly and annual rainfall pattern change from Melbourne through to Cairns? Do you think the rainfall in Rockhampton is sufficient to make pastures green and nutritious? What other things would you like to know about the climate to be certain of your answers? (Check back to pages 46-8.)

The countryside surrounding Belmont varies in topography. Along the streams such as the Fitzroy River the land is fairly flat, and sandy alluvial soils support valuable grazing. Find out what an alluvial soil is like. Try to obtain a sample near your school. What colour is it? How is it formed? Only about half of Belmont is flood-safe, and during periods of heavy rain, such as in January-February of 1971, the property has been completely cut off from all outside communication. During such times a high level of skilled management is required; experienced stockmen are also put to the test as they ride across swirling waters to visit and move cattle.

As a result of the heavy January-February rains in 1971 and the continuation of a good season, grasses stood 2 metres high in places. This contrasted greatly with the situation twelve months before, when the ground was practically bare. What else does this tell you about the climate?

Staff

The overall activities on Belmont are supervised by the officer-in-charge, who is responsible to the CSIRO Division of Animal Genetics in Brisbane. As an experienced agricultural worker (and a university graduate in Agricultural Science), the officer-in-charge coordinates the work to be done on the property with research activities. Routine jobs are carried out by the overseer and his staff of two or three men; in addition, there are two or three jackaroos, all experienced cattlemen. During peak working periods extra labour is taken on.

Buildings and facilities

As well as the homestead and other housing in which the officer-in-charge and various workers live, other buildings and facilities provide for a wide range of activities:

- Extensive wooden cattle yards (post-and-rail) facilitate the handling of large numbers of cattle. The yards are equipped with circular drafting pens so that cattle can be drafted into any of six different yards.
- Adjacent to the cattle yards are sheds belonging to the research unit. Together with housed pens for animals, the sheds contain specialised equipment necessary for the research being carried out.
- A hay shed contains lucerne hay and hay cut from Belmont's sown pastures.
- A number of machinery sheds house several tractors, a truck, two landrovers and other agricultural equipment such as hay balers and ploughs. A motorbike is found very useful for odd jobs, but all stock movements are done on horseback. The hardy landrovers are invaluable when it comes to tackling the hazardous terrain of the paddocks by vehicle. A large bulldozer is kept working nearly every day.

Design an ideal layout for the homestead buildings listed above. You will have to consider what each building is used for and how the activities are co-ordinated. Figure 6·3 only shows their general position.

Activities

Because of the research conducted at Belmont, the everyday activities are not typical of other properties in the area. What do you think would be the main differences between the types of activity at Belmont and those on a normal cattle farm? Cattle have a great deal of care and attention paid to them at Belmont. The attention begins at birth when every calf is weighed and given an eartag. Careful records of cows and their calves are kept and analysed. Every beast is weighed periodically and has its progress recorded. Calves

Table 6.4: Average monthly rainfall figures (millimetres)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Melbourne	48	51	56	58	49	52	49	51	56	67	59	60	656
Dubbo	51	38	51	45	37	62	48	38	33	38	49	48	538
Rockhampton	170	185	90	68	32	71	45	21	24	51	67	126	950
Cairns	419	432	447	273	120	73	40	37	36	61	77	187	2,202

are weighed using a mobile set of scales placed in the back of a landrover. Sometimes the work can be dangerous, especially if the calf is being guarded by a possessive mother.

Many of the animals are used in research programmes. Thus Belmont animals are handled a great deal for various purposes, and much time and labour has to be devoted to this. The cattle have to be mustered frequently and routine checking of stock is essential. Because they are handled so often, the animals are usually reasonably quiet. The fact that no dogs are used on Belmont helps to minimise disturbance of the cattle.

An extensive programme of pasture improvement has been implemented. Most of the heavily timbered country has been cleared and sown down to what is now the standard pasture of green panic, buffel grass and siratro (figure 6·9). As a general rule, 125 kilograms of superphosphate with molybdenum has been applied annually to each hectare of sown pasture. What is a trace element?

Researchers trying to develop tropical pastures have always been plagued by the problem of establishing a tropical legume to return adequate nitrogen back to the soil. Finally the CSIRO released siratro, which has established itself magnificently on Belmont. The development of such legumes gives enormous scope for improved soil fertility, and hence a boost in production is inevitable.

Research

Theme: The central aim of the research is to find out what makes an animal suitable for producing beef efficiently under northern Australian conditions. The approach is to measure and compare the characters of contrasting breeds (Brahmans and Africanders as tropically adapted breeds, and Herefords and Shorthorns representing temperate breeds). See figures 6·8 and 6·10. The family background of beasts is also studied. Why is this important?

The knowledge thus gained, and its testing in the Belmont breeding programme, provides guidance on the techniques most suited to tropical cattle breeding. The work is particularly concerned with the ability to endure the stresses or problems found in the northern environment. These stresses include:

- heat stress
- parasite stress
- nutritional stress.

Breeding programme: Herefords and Shorthorns are both British breeds belonging to the subspecies *Bos taurus*. Animals from this subspecies are accustomed to a temperate European-type climate. With good management they have high fertility and grow well, but it is well known that the harsh, humid and hot northern climate limits their efficiency.

On the other hand, the Brahman and Africander breeds have been developed from Zebu breeds, which are adapted to tropical environments and seem to handle the stress conditions of northern Australia much better. To what extent do crossbreds combine the attributes of both subspecies? This is another question which the Belmont research team is trying to answer.

At the moment, the numbers of Zebu-type cattle in Queensland are still small but are on the increase. Africander numbers are especially small, the main herd being at Belmont. Belmont carries over 1,500 head of cattle, including 500-600 breeding cows (table 6·5). The breeding herd is mated each year for a restricted period of seven weeks between January and March.

Table 6·5: Composition of the breeding herd

	Nos. Normally Mated
Brahman-cross	140 females, 4 bulls
Africander-cross	140 ,, 4 ,,
Shorthorn-Hereford (unselected)	100 ,, 3 ,,
Shorthorn-Hereford (selected)	100 ,, 3 ,,
Brahman purebreds	40 ,, 2 ,,
Africander purebreds	40 ,, 2 ,,

The creation of the Brahman-cross and Africander-cross lines is explained in figure 6·11. Can you follow this diagram? What could be the grandparents of an Africander-cross line? What could be the great-great-grandparents of a Brahman-cross line? Why is the keeping of such records so important? Selection of the crossbreds and the culling (cutting out of the family tree) of animals not wanted is based on:

- fertility
- weight of animal when weaned
- post-weaning weight gain
- resistance to ticks
- coat type.

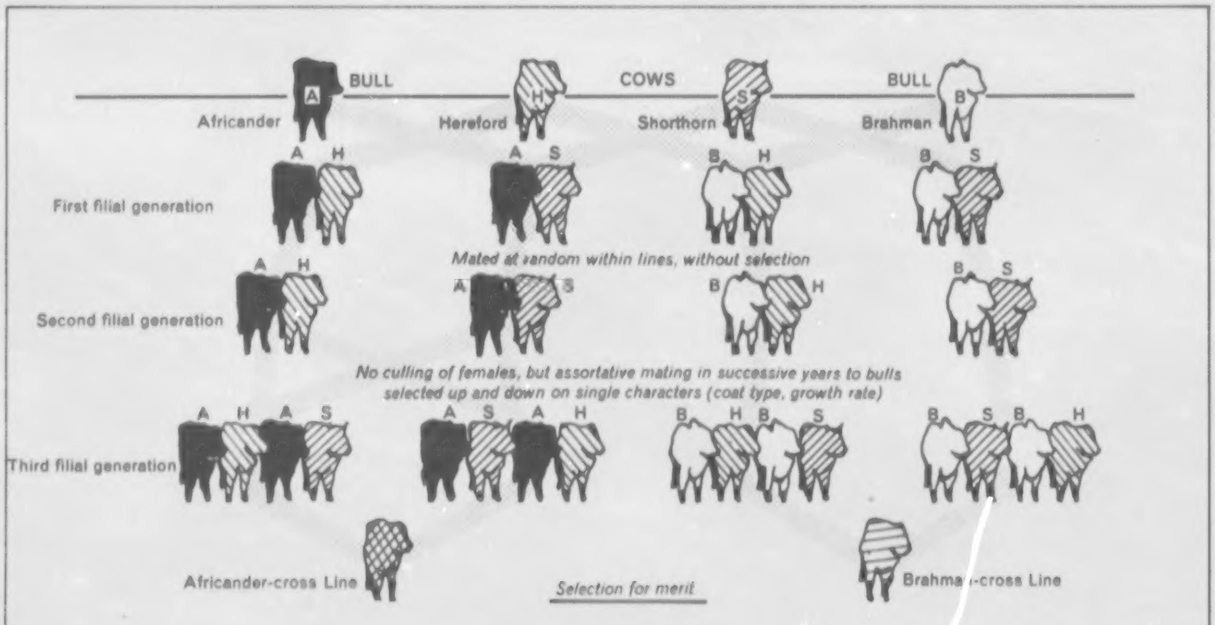
The whole of this research will be useless unless the northern cattle industry can adapt and make use of the findings from Belmont station. Only a short summary of a very small part of the research has been provided here. However, it illustrates the vital nature of our northern cattle industry with its many problems and many solutions. The changing conditions of the Australian cattle industry all have their own special difficulties. There is no single remedy or solution.

Figure 6.8: Young Brahman purebreds being used in research

Figure 6.9: Mustering—note the improved pastures of green panic, buffel grass and siratro. How high is the pasture? How would you describe it?

Figure 6.10: A mixture of young animals of different breeds at Belmont. All are of the same age (note the different sizes). From left, Africander-cross, Brahman-cross, Hereford shorthorn (much smaller), Africander-cross. Behind are some purebred Brahmans

Figure 6.11


BULL
COWS
BULL
A
Africander
H
Hereford
S
Shorthorn
B
Brahman
First filial generation
A H
A S
B H
B S
Mated at random within lines, without selection
Second filial generation
A H
A S
B H
B S
No culling of females, but assortative mating in successive years to bulls selected up and down on single characters (coat type, growth rate)
Third filial generation
A H A S
A S A H
B H B S
B S B H
Africander-cross Line
Selection for merit
Brahman-cross Line

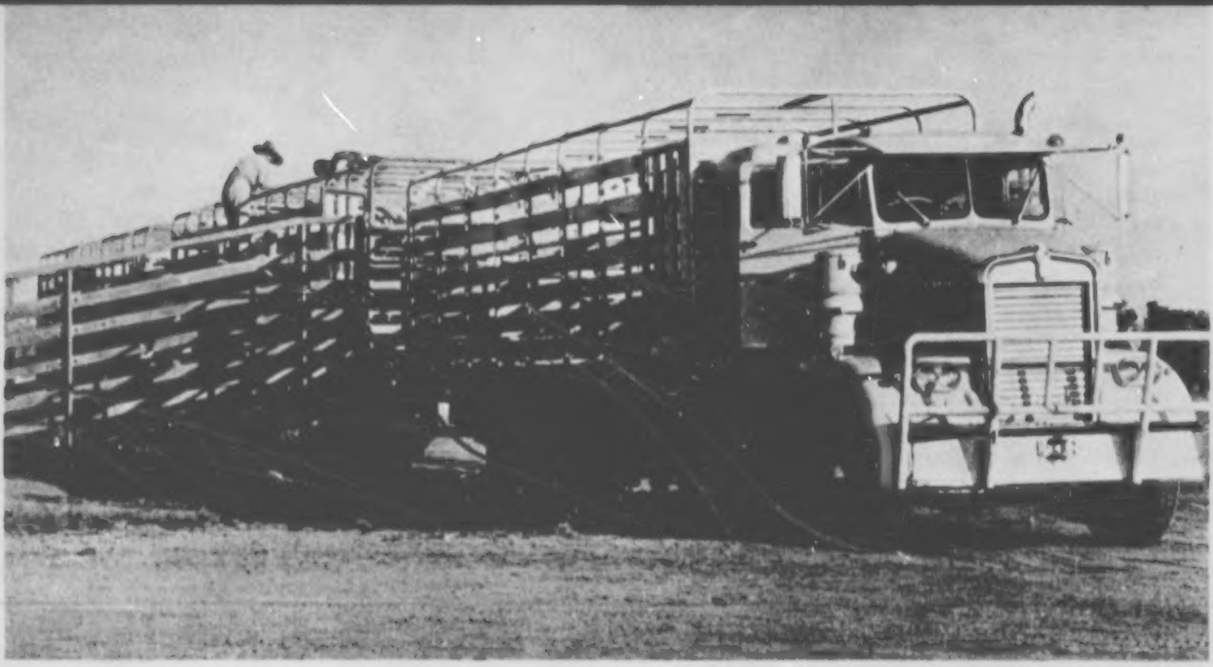


Figure 6.12: Loading cattle into a road train

For a thorough analysis of any industry, examining the production of a commodity alone is not enough. What other aspects of the beef cattle industry should we now consider?

Transport

Meatworks in the Rockhampton area obtain their carcass supplies not only from the Rockhampton district but also from far away in western Queensland. Transport is obviously a very important consideration for these distant stations. The oldest form of transport is droving or 'walking' the cattle to their destination. Walking cattle today depends very much on the distance to be travelled. Over very short distances, walking may be the most economical form of transport. To a large extent walking avoids the problem of 'bruising', which occurs when cattle are jostled about in road or rail trucks for any length of time. Whether or not cattle can be walked also depends a great deal on the amount of feed and water available. What are some disadvantages of droving?

Today, most long-distance movement of cattle is done by rail or road (refer to figure 6·12). In western Queensland, animals are often walked or taken by truck to the nearest railhead, where they are loaded into rail trucks and transported by train to the east coast. Rail transport is comparatively cheap but has several disadvantages. What do you think some of them would be?

Moving beasts by road truck involves the same problem of bruising that occurs with rail transport. In fact, the problem may be even worse if trucks are badly driven or if they are overloaded or underloaded. On the other hand, road transport is direct and very quick. Trucks are extremely mobile and can virtually load and unload at any point, whereas double handling is often necessary with rail wagons. Movement by rail generally takes longer, but cattle do not suffer greatly if they go without food for a few days; their decline in condition is slow. If the journey is long, the cattle are unloaded and watered. (In the United States they are not only watered but also fed when on long train journeys.) Sometimes rail travel may be very direct, especially if the train can travel directly to the meatworks, as at Rockhampton. Special beef trains have priority over passenger trains in Queensland, and thus transport of beef by rail can sometimes be extremely swift.

Meatworks at Rockhampton

There are two main abattoirs and meatworks near Rockhampton. Both have access to road and rail. The biggest is the Lakes Creek meatworks, which

Figure 6.13: Handling refrigerated containers **(Gregory Heath)**

is owned by the Central Queensland Meat Export Company (CQME). This company is a subsidiary of Vestey Ltd, which also owns the Blue Star shipping line. The Lakes Creek abattoirs are capable of slaughtering and processing 1,000 beasts per day. The processing is similar to that in a car assembly plant, except that the beasts are being dissected and separated instead of assembled. Each slaughtered animal moves along a conveyor belt where teams of workers carry out their particular function in processing the carcass.

Port Alma

From the meatworks, the beef is transported in refrigerated vans to Port Alma, which is the port for the Rockhampton region. Export ships load at Port Alma and then either head towards the overseas market or move north and pick up more cargo at other major beef centres.

Trends

Port Alma's future as a port is limited, for to keep pace with the modern trend towards containerisation, an enormous amount of money will need to be spent on facilities. Unless this provision for containerisation is made, competition from more up-to-date ports could become stronger. Already there are signs that it could be cheaper to transport beef to Brisbane by rail and to ship it from there. Brisbane docks are capable of handling container ships, but do not yet have the capacity to handle large quantities of export meat in addition to maintaining their present activities.

What other ports on the Queensland coast could be developed to encourage an increase in exports? If you were expanding a port in order to export beef, what facilities would you provide?

With high beef prices, the present trend of the beef industry is to expand. Recently the numbers of beef cattle in Australia have risen at an annual rate of 8 per cent, which is an enormous increase for this type of animal industry. While beef prices are high and markets are available, there seems to be no end to this increase.

But will the day come when synthetic meats can be produced economically and on a large scale? As an intermediate consumer, the animal is an inefficient beef producer from an energy point of view. It would be much more efficient to produce high-protein meat from high-protein cereal crops. Synthetic meat that looks and tastes like natural meat has already been produced, but only on a small and expensive scale of production. What of the future? Why do we need research stations? How can the information discovered and developed on a research station be applied to farms?

This study has been concerned particularly with improvements or change. The geographer's task is to study not only what is present at any one time, but how the system itself will change through time.

FURTHER ACTIVITIES

The main outputs from the Belmont research station are 'beef' and 'ideas'. What are the main inputs?

Investigate the following points by consulting a farmer who raises beef cattle in your area (or by referring to secondary sources), and compare your findings with the corresponding data for the Belmont station:

- The type and number of cattle raised
- The number of cattle per hectare of grazing land (stocking rate)
- Nature of pasture improvement
- Nearest abattoirs and market
- Transport used
- Ideas of change, and how the farmer receives them
- The major problems he is facing.

7

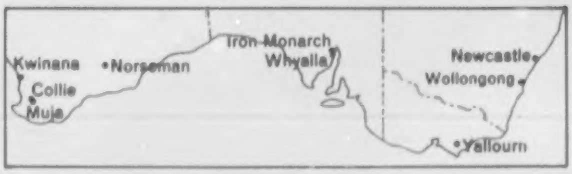
The mining system: Norseman, a 'robber industry'

Another kind of system that geographers are concerned with is the mining system. By no means are all the resources that man develops connected with the soil. Many more occur under the soil, in the form of minerals for mining. However, before man can start mining these, he must realise their usefulness. The existence of iron ore in Western Australia, or brown coal in Victoria, was known for a long time before mining commenced. First man had to estimate the size and quality of the reserves, and then plan the means of transport and the size and scale of mining operations. Then he was in a position to apply the 'inputs' into the mining system to make it work, namely to produce the mineral he wanted. This system requires a lot of preparation and planning if it is to work properly. Perhaps some examples will make this point clearer.

What do you understand by the term a 'robber' activity or industry? Does it suggest something bad to you? Mining for gold, as at Norseman, W.A., and for coal, as at Collie in the same state, are both robber industries. Do you think these are 'bad'? Would you include some examples of bad farming in your definition? Overcropping, overgrazing and overfishing can all be called robber activities. These surely are 'bad'.

What is the point of gold mining? Gold is an indestructible resource that is also precious. Therefore it has been highly sought after. What are the two main uses of gold? Find out the total weight of gold that was mined last year in Australia.* Has this amount changed much over the last ten years? Which four minerals have the greatest value of production in Australia at the present time? When something precious is mined it has a fascination about it—some people are convinced they will make a quick fortune, like the diggers in the old goldrush days! (figure 7·2).

If gold itself is interesting it means, surely, that the methods of mining it must be interesting too.



Read this account written by a boy about your age on his first visit down the deep shaft mine (670 metres) at Norseman Number 1.

'As soon as we entered the mining compound I was struck by the jumble of equipment lying around, untidy and rusty. Probably, I gathered, the mine will only run for another few years.

'There is one 7½ hour shift each day. The miners travel down in skips which later transport the ore back to the surface. The skip in which we descended can hold 8-10 men. A system of bells stops or releases the cars on any of the 24 levels. The vertical depth of this mine is 670 metres, but you actually travel down further as the shaft is at an angle. The top of the skip is only inches from the "roof" in many spots, so you must not lift your head on the way down. Four men have been killed here in this way.

'When I was in the level (horizontal shaft) near the bottom, I was naturally very interested in the "roof". In every part of the mine we saw, it is supported in one way or another. After blasting, the rock is inspected to see what sort of support is needed. Rock-bolts are inserted in most places. These are driven into certain parts of the roof to "hold" the rock together. Wooden pillars are used, but very rarely as far as we could tell. Often pillars of rock are left in vital spots, to provide maximum support. Ventilation circuits are obtained by the use of underground fans. The main outlets for air are old, disused shafts.

'Electric power is supplied underground on all main operating levels. At our shaft it is taken down at 3,300 volts and then stepped down to 415 volts for operation. Batteries, used in large quantities, are primarily for the railway trucks (see figure 7·10). We spent two hours underground. I

---

* See the Commonwealth Year Book

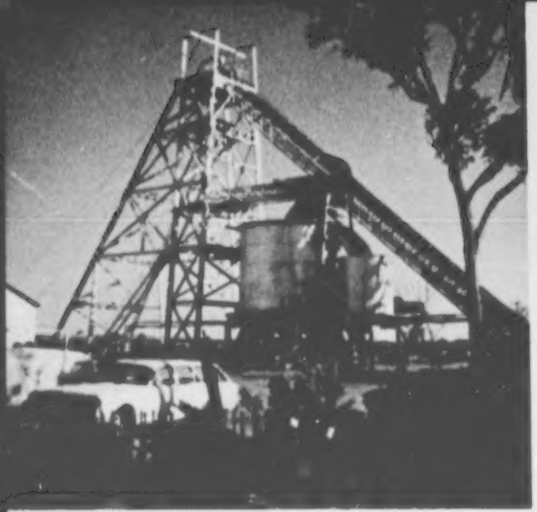


Figure 7.1: Superstructure at the head of the mine shaft, Norseman, W.A. In what other ways does mining affect the local landscape?

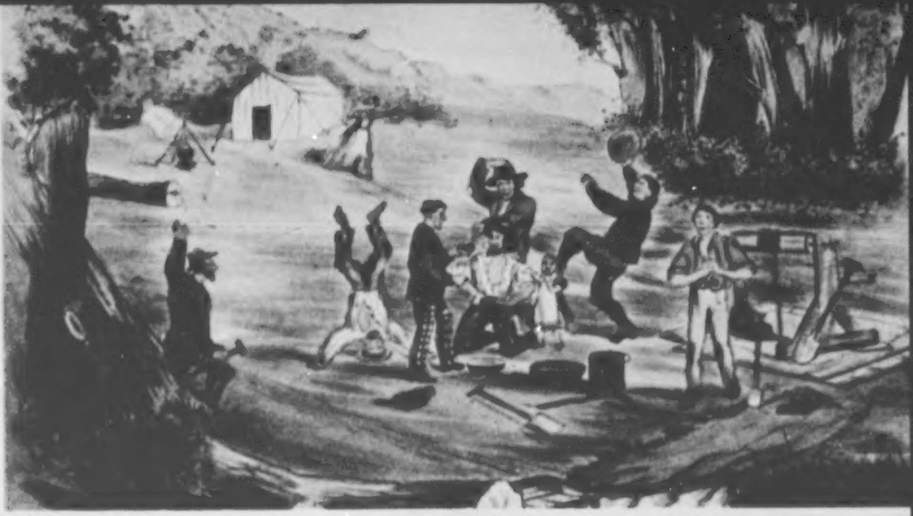


Figure 7.2: 'Prospecting for Gold, or: Rewarded at Last'

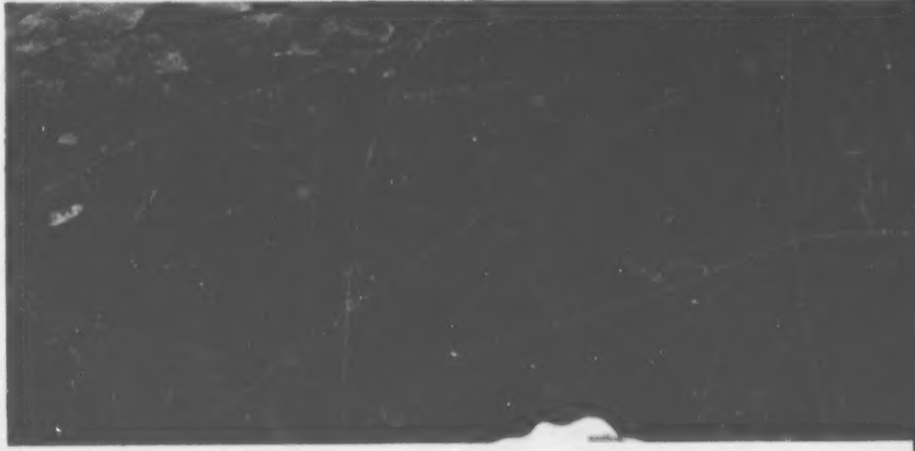


Figure 7.4: In a level 550 metres down at Norseman. There are many reasons why a close watch must be kept on the roof of a level. What are two important reasons?

Figure 7.3: A party of schoolboys about to go down in a skip at Norseman Number 1

Figure 7.5

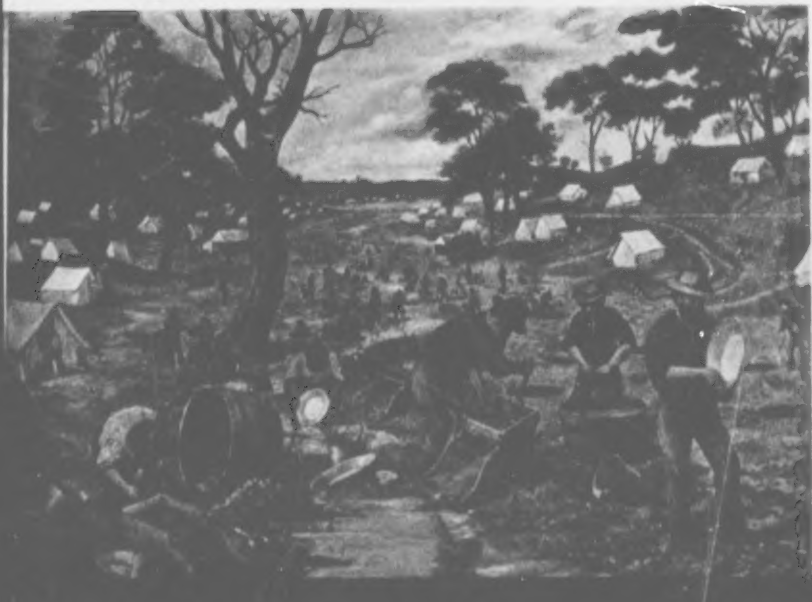


Figure 7.6

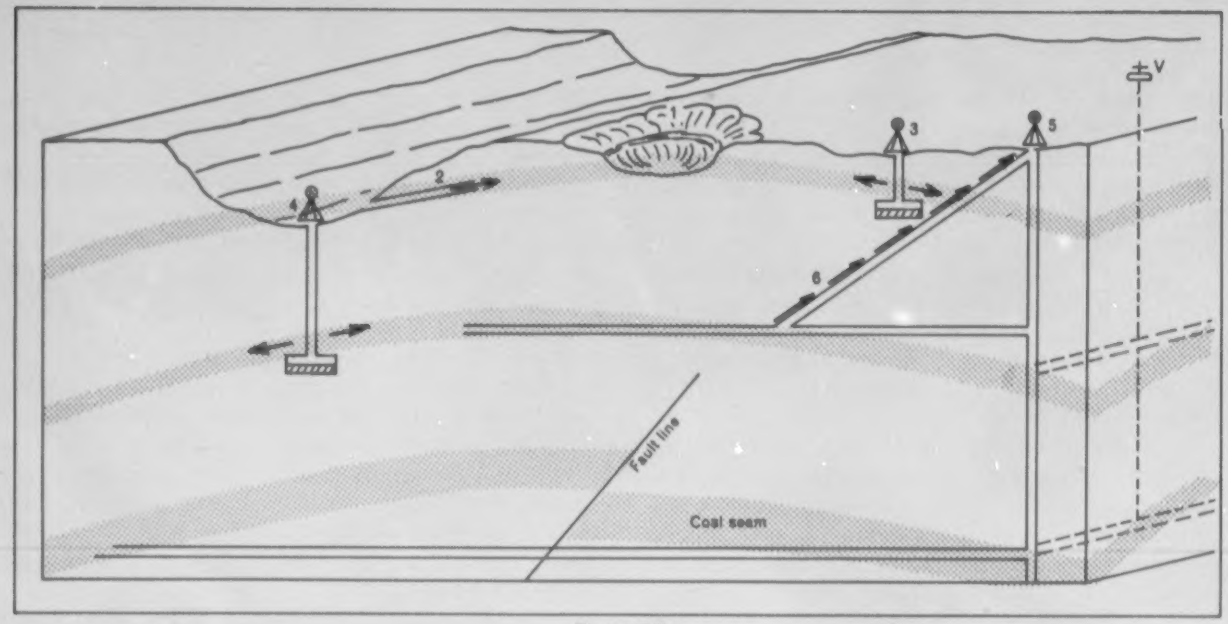


Figure 7.7

1. Open-cut mining
2. Adit or tunnel mining—why does this normally go uphill?
3. Shallow shaft mining—what is the purpose of the sump at the bottom of the shaft?
4. Deep shaft mining
5. Deep horizon mine—what is the advantage of an horizon line?
6. Inclined shaft mining, using a conveyor belt—why is a conveyor belt shaft more suitable than a lift shaft for modern mining of heavy minerals such as coal?

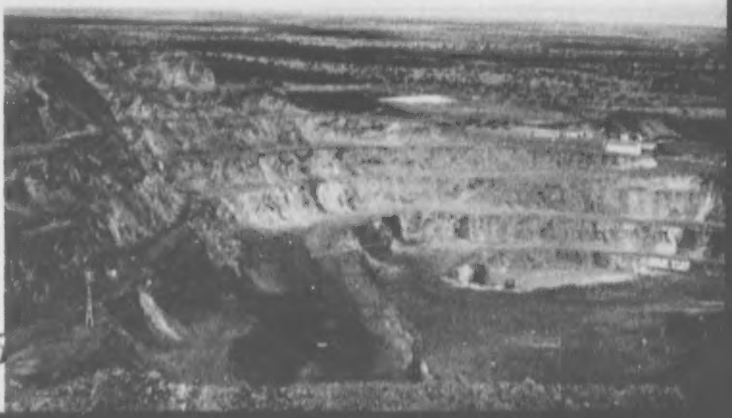
V. Ventilation shaft

Figure 7.8: Coal mining at Collie, W.A. What sort of mining is shown here? Look carefully at this photograph and then comment on the ventilation used. (This mine is not more than 150 metres deep.)

Figure 7.10: An electric train underground. What type of mining is most likely to have this type of transport? Why?

Figure 7.9: A 7-tonne grab in action at Iron Monarch, S.A. What sort of mining is shown here? Can you detect the means of power used by this crane?

Figure 7.11: An open-cut mine with benches for machinery at Iron Monarch, S.A. Estimate the depth of the existing open-cut. (The pylons shown are each about 15 metres high.) High-grade iron ore (over 60 per cent iron in the ore) is known to exist for another 250 metres below this level!



shall never forget the experience or the things I learned. It was great!'

It is obvious from the above description that Norseman Number 1 is a mechanised mine. How do you think gold was mined in the areas shown in figures 7·5 and 7·6?

Figure 7·7 will indicate to you the many different ways in which minerals can be mined from the earth's crust. Each of the methods shown is used in mining in Australia. Find out a local example for each method. It does not matter what the mineral mined is.

At every gold mine there must be a processing plant nearby. At Norseman Number 1, only about 12 grams of gold are refined from every tonne of ore raised. Many industries that depend on raw materials from mines are built near the mines. These industries are called 'resource-oriented' industries. What other examples can you think of in Australia? Are the BHP steelworks at Newcastle in N.S.W. 'resource-oriented'? What about the BHP steelworks at Whyalla, S.A., or the BHP steel rolling mills at Kwinana, W.A.? Find these places in your atlas. From where does each get its raw materials?

Refer to figure 7·12, a flow chart showing the processing involved at Norseman.

List the different methods of transport used in all stages from the movement of gold ore from the base of the mine shaft to the finished product leaving the gold mining compound.

Sometimes mine machinery breaks down or miners go on strike. Why is it necessary to have storage bins as shown half-way through this flow chart? Are there any by-products shown on the chart? Do they appear to be of any use? (See figure 7·18.)

Draw up your own simple flow chart for a resource-oriented industry. (This could be for electricity production at Yallourn in Victoria, for iron and steel at Newcastle in N.S.W., etc.)

No one knows just how much gold there is within 15 kilometres of Norseman. However, the *economic reserves* for Norseman Number 1 are likely to run out by 1973. What is meant by economic reserves?

Gold production at Norseman is declining (see table 7·1). These figures also show you why Norseman will possibly cease production in the next five years. Draw this information up in the form of a graph and you will see this more clearly. Use different coloured bars to indicate the amounts of ore treated and gold produced, and then three different coloured lines to indicate mining costs, treatment costs and total operating costs. You will have to choose your scales carefully!

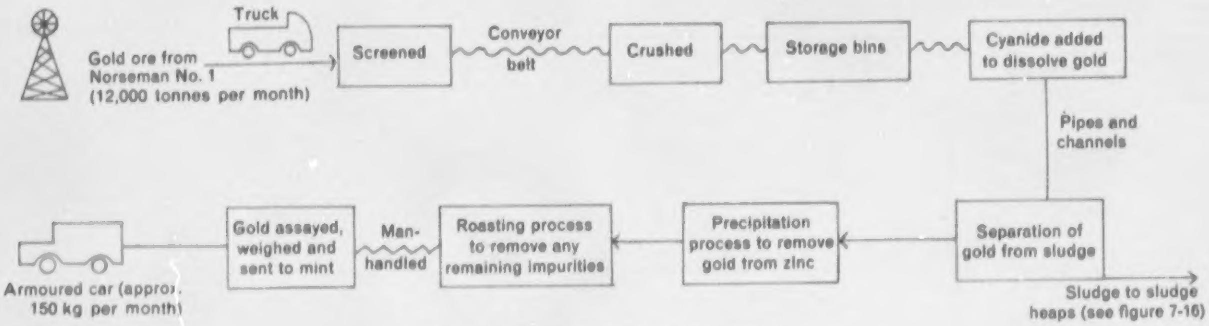

Truck
Gold ore from Norseman No. 1 (12,000 tonnes per month)
Screened
Conveyor belt
Crushed
Storage bins
Cyanide added to dissolve gold
Pipes and channels
Separation of gold from sludge
Sludge to sludge heaps (see figure 7-16)
Precipitation process to remove gold from zinc
Roasting process to remove any remaining impurities
Man-handled
Gold assayed, weighed and sent to mint
Armoured car (approx. 150 kg per month)

Figure 7.12: Processing at Norseman

Table 7·1

	Units	Year ended 30 June 1968	Year ended 30 June 1969	Year ended 30 June 1970
PRODUCTION				
Total ore treated	tonnes	184,000	179,000	162,500
Gold produced	kg	2,705	2,379	1,848
COSTS				
Mining (not including labour)	$/tonne	6.90	7.26	7.99
Treatment	$/tonne	2.50	2.61	2.74
Total operating (including labour)	$/tonne	12.60	13.17	14.03

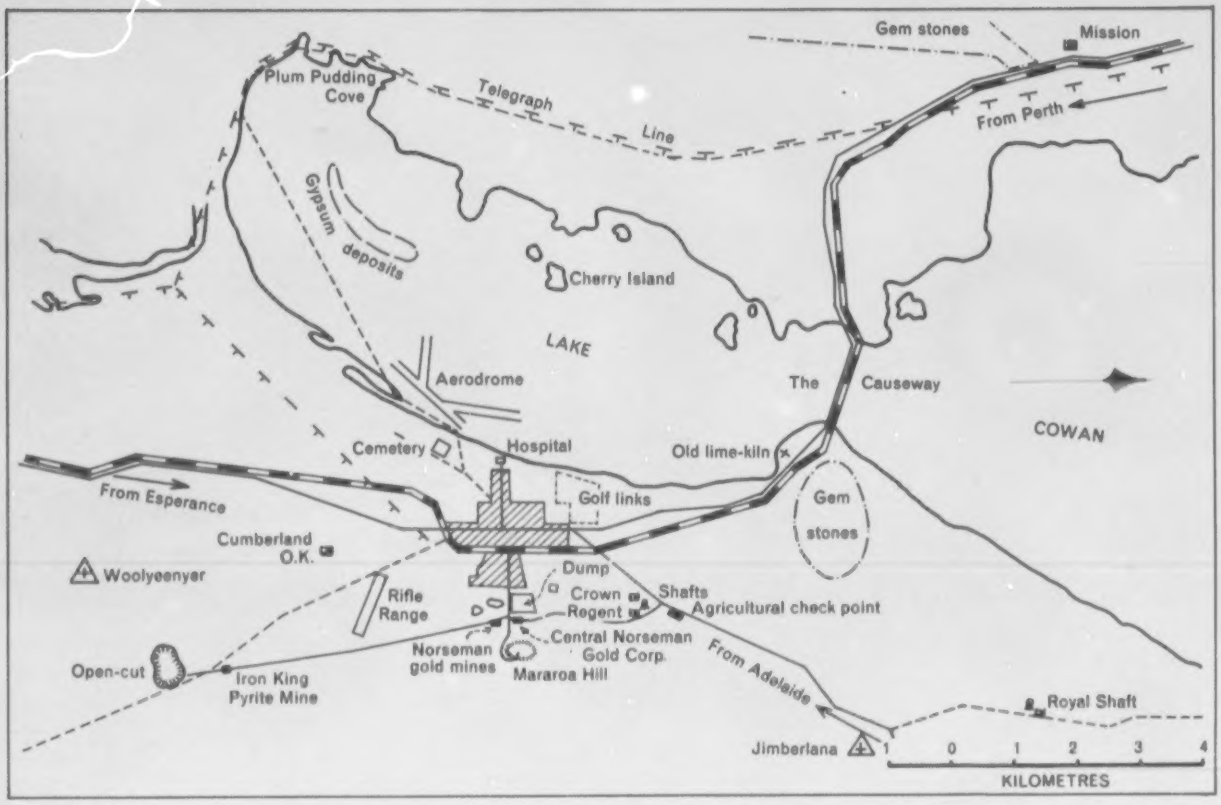

Gem stones
Mission
Plum Pudding Cove
Telegraph Line
From Perth
Gypsum deposits
Cherry Island
LAKE
Aerodrome
The Causeway
COWAN
Cemetery
Hospital
Old lime-kiln
From Esperance
Golf links
Gem stones
Cumberland O.K.
Woolyeenyer
Dump
Rifle Range
Crown
Regent
Shafts
Agricultural check point
Central Norseman Gold Corp.
Norseman gold mines
Mararoa Hill
Open-cut
Iron King Pyrite Mine
From Adelaide
Royal Shaft
Jimberlana
1 0 1 2 3 4
KILOMETRES

Figure 7.13: Norseman and environs

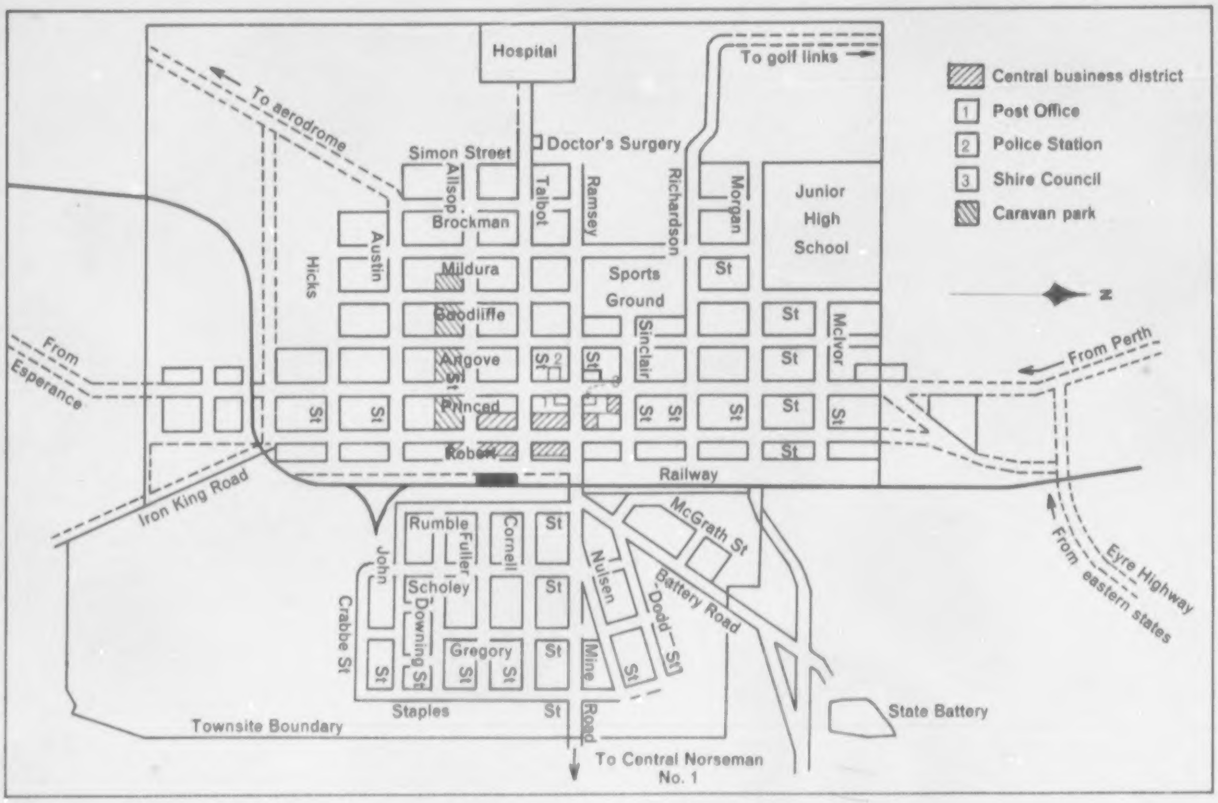

Hospital
To golf links
To aerodrome
Central business district
1 Post Office
2 Police Station
3 Shire Council
Caravan park
Simon Street
Doctor's Surgery
Allsop
Talbot
Ramsey
Richardson
Morgan
Junior High School
Brockman
Austin
Hicks
Mildura
Sports Ground
St
Goodliffe
Sinclair
McIvor
From Esperance
Argove St
From Perth
Princed
Robert
Railway
Iron King Road
Rumble
Fuller
Cornell
McGrath St
John
Scholey
Nulsen
Battery Road
Dodd St
Crabbe St
Downing St
Gregory St
Mine Road
Eyre Highway
From eastern states
Staples St
Townsite Boundary
State Battery
To Central Norseman No. 1

Figure 7.14: Norseman town plan

Figure 7.15: This 18-tonne capacity front-end loader at Iron Monarch, S.A., is worth $250,000. Estimate the height of the machine by comparing it with the schoolboys and then the coach. What is the diameter of the tyres? (They are filled with air and water and are worth $4,000 each!) Nowadays a large mine with bigger machinery is more profitable than a smaller mine. Why is this so?

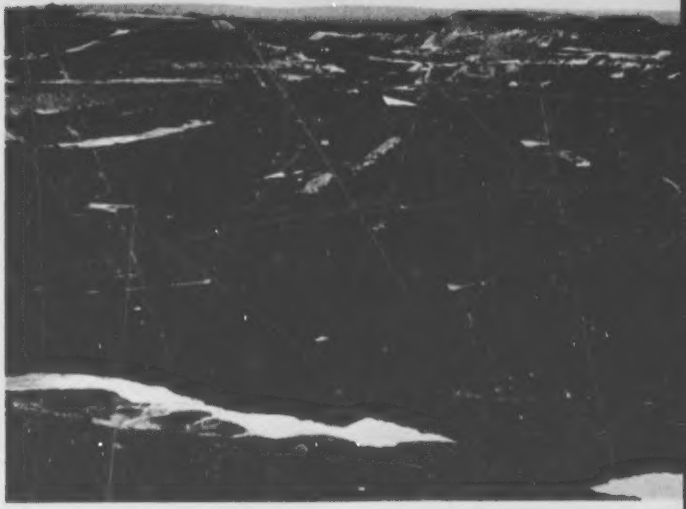


Figure 7.16: What mineral is being mined in this open-cut mine at Muja in W.A.? What does this photograph tell you about overburden at an open-cut mine?

Figure 7.17: The electricity power station at Muja, W.A. This power station is only 1 kilometre from the open-cut shown in figure 7.16, yet it supplies power to Perth, over 100 km away. Why has this power station been built here and not in Perth where the electricity is used? How is coal brought to this power station?

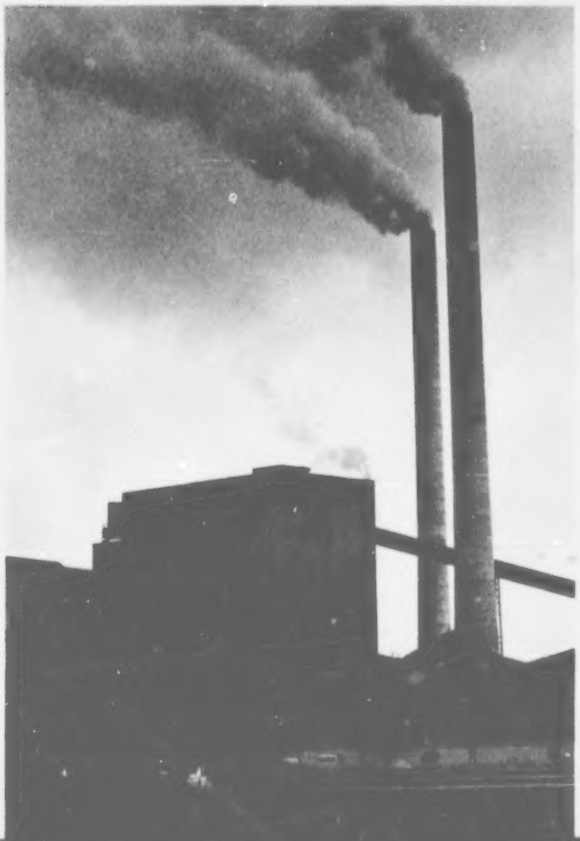
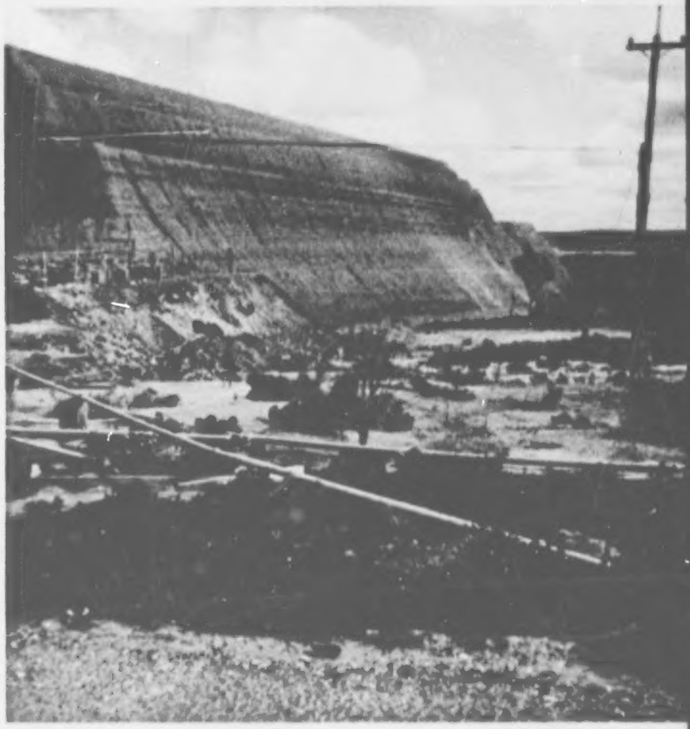


Figure 7.18: Sludge pile at Norseman. What can you see in this photograph that indicates how the company prevents the sludge from slipping down? Do you think these piles of sludge standing about 60 metres high are spoiling the countryside? How can mining tips be controlled? Is it worth the cost?



There is a standard price for gold. In Australia it was $79 per fine ounce (approx. $2.60 per gram) in 1973, having risen from the previous price of $37 per fine ounce at which it had remained constant since 1937. At present the government pays gold mining companies a subsidy based on the amount of gold produced. How could these two factors affect the future of gold mining at Norseman? Do you think it is wise to mine all we can now of our economic reserves, or should we leave some for future generations? Does the same point apply for other minerals such as coal, iron ore, bauxite for aluminium, or phosphates? (See study 8, Christmas Island.)

Norseman town

People in Norseman are worried that if Norseman Number 1 closes down the town will die and may even become a ghost town. Look at figure 7·13. What evidence can you find on this map that it is unlikely that Norseman will ever die out completely? List all the different activities you can find. Why are the railway and roads so important to the continued existence of Norseman? What do you think would be the least attractive aspect of life in Norseman? What would you like about it that is different from your home town?

Figure 7·14 shows the town plan of Norseman. It is a well-planned town, mainly because one company (Western Mining Corporation) has been responsible for most of the planning, development and building. Which part of the town would you choose to live in? Why?

Conclusion

The mining 'system' is a very interesting one. It is a relatively simple one, for as in the case of Norseman there are few outputs, namely gold and a little silver. The outputs have to pay for all the inputs into the system. For Norseman these inputs include labour in the mines, the cost of purchasing and servicing machinery, . . . list four other inputs.

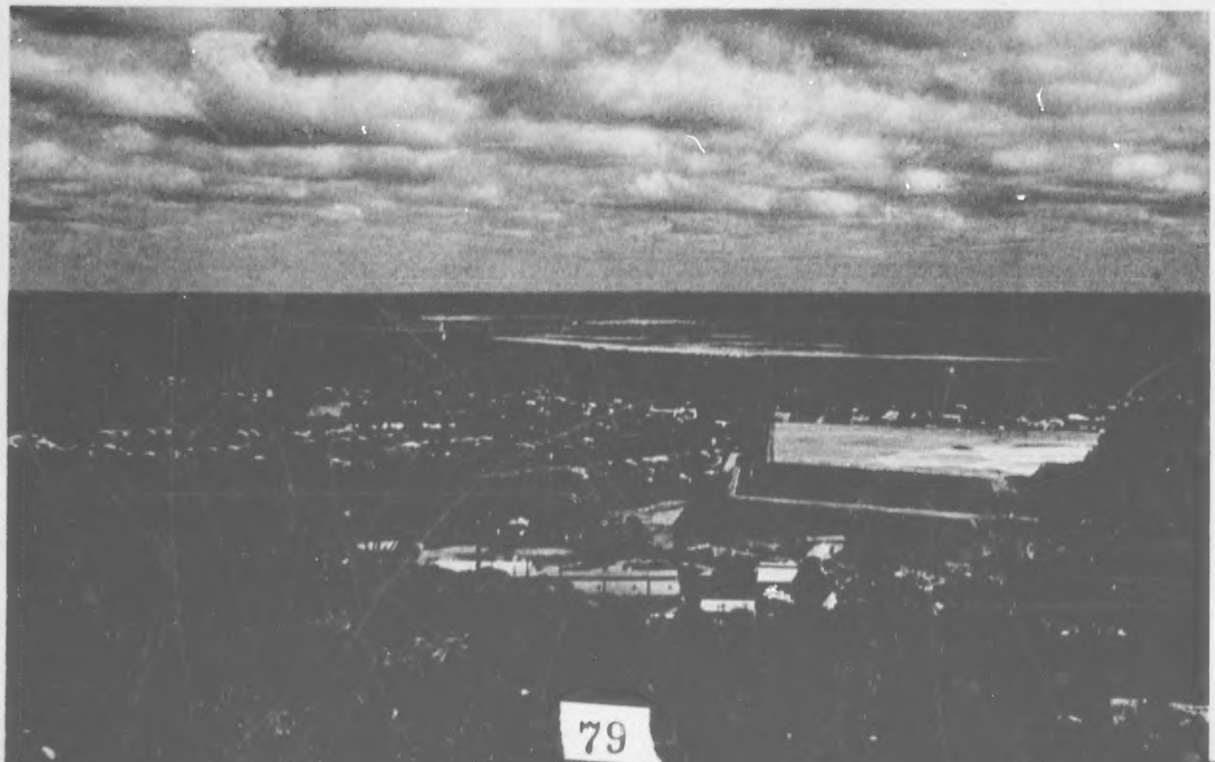
A miner may be taking something from our environment that can never be put back in its original form. To that extent his is a 'robber industry'. However, miners are fascinating people, and their mines are interesting places — never miss an opportunity to visit one!

FURTHER ACTIVITIES

What is meant by the gold standard? Where is much of the world's gold stored? Where is most of Australia's gold stored? Why is so much of the world's gold dug out from one hole in the ground and then stored in another? Where are the largest gold mines in the world?

You may already know the answers to these questions — if you do not, you may like to read about gold in a modern encyclopedia in your school or town library.

Figure 7.19: Norseman town from Mararoa Hill



8

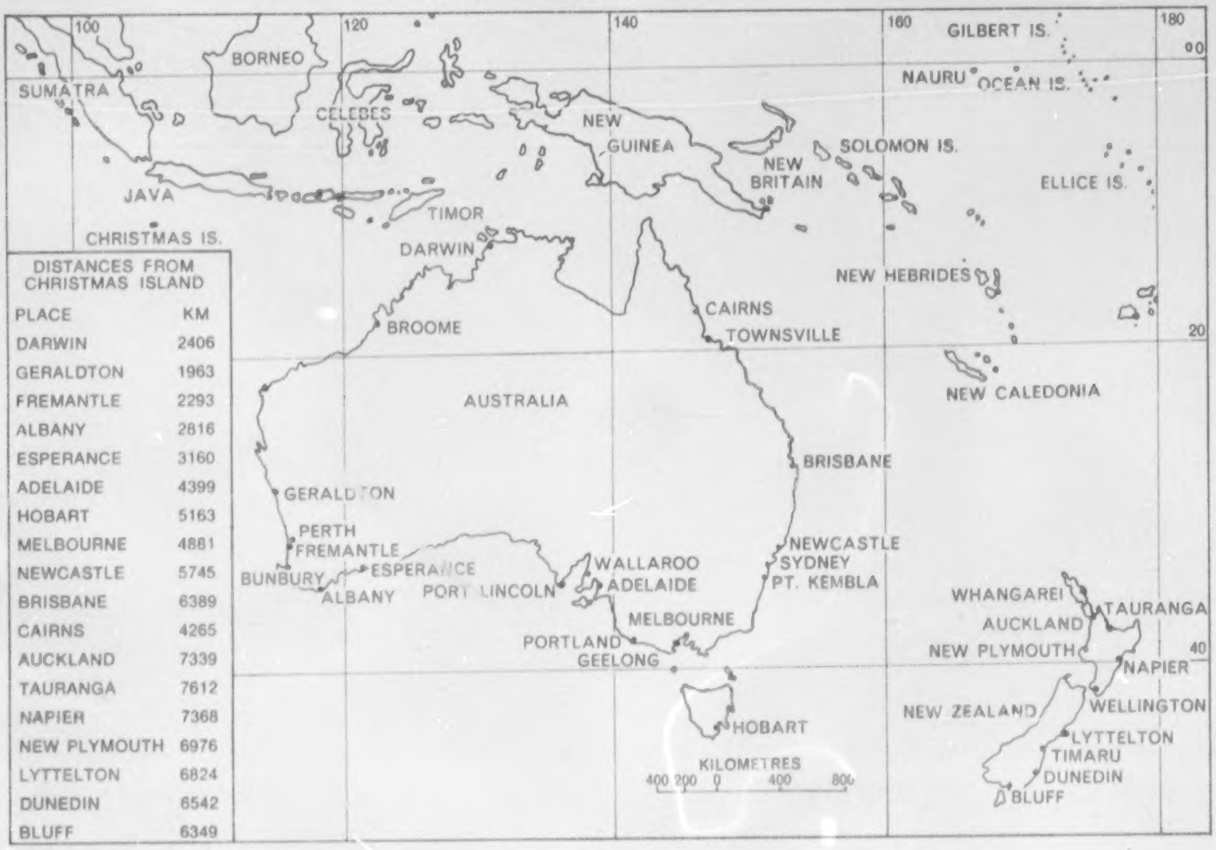
Christmas Island

An island made from phosphate

This mining system is different from any other studied so far in that since it occurs on a small island it is total. This means that the mining operations affect in one way or another every aspect of man's activity on the island. In many ways it can appear destructive, because in the end it will die out after the resources have been fully worked. The island must, of course, have good communication links back to the areas where the mineral is sold.

Where is Christmas Island? It is a tiny, remote island shown on some maps as a mere dot and often not shown at all. Its latitude is 10°S and its longitude is 106°E. How far is it from Java, and how far is it to the nearest part of the Australian coast? What is the direction from Broome to Christmas Island? (See figure 8·1.)

The only ships to call at Christmas Island are cargo vessels which come to take away the phosphate, and some which call to bring supplies to the mining community which lives there. Occasion-



DISTANCES FROM CHRISTMAS ISLAND

PLACE	KM
DARWIN	2406
GERALDTON	1963
FREMANTLE	2293
ALBANY	2816
ESPERANCE	3160
ADELAIDE	4399
HOBART	5163
MELBOURNE	4881
NEWCASTLE	5745
BRISBANE	6389
CAIRNS	4265
AUCKLAND	7339
TAURANGA	7612
NAPIER	7368
NEW PLYMOUTH	6976
LYTTELTON	6824
DUNEDIN	6542
BLUFF	6349

100
120
140
160
180
0
20
40
SUMATRA
BORNEO
CELEBES
NEW GUINEA
NEW BRITAIN
SOLOMON IS.
GILBERT IS.
NAURU
OCEAN IS.
ELLICE IS.
JAVA
TIMOR
CHRISTMAS IS.
DARWIN
BROOME
CAIRNS
TOWNSVILLE
NEW HEBRIDES
NEW CALEDONIA
AUSTRALIA
BRISBANE
GERALDTON
PERTH
FREMANTLE
BUNBURY
ALBANY
ESPERANCE
PORT LINCOLN
WALLAROO
ADELAIDE
NEWCASTLE
SYDNEY
PT. KEMBLA
MELBOURNE
PORTLAND
GEELONG
HOBART
KILOMETRES
400 200 0 400 800
WHANGAREI
AUCKLAND
TAURANGA
NEW PLYMOUTH
NAPIER
NEW ZEALAND
WELLINGTON
LYTTELTON
TIMARU
DUNEDIN
BLUFF

Figure 8.1: Location map

ally, passenger ships cruise close by to give the tourists a glimpse of the island, and between April and October a few round-the-world yachtsmen find safe anchorage and fresh supplies in Flying Fish Cove.

It is hard to imagine a remote, tropical island in this technological age when men journey to and from the moon and keep to a strict schedule while doing so, but Christmas Island *is* remote; it takes three days sailing from Singapore or six days sailing from Fremantle for supply ships bound directly for the island. There is no air service, although plans are now under way to start constructing a small airstrip. Mail arrives from Australia about once every three weeks and from Singapore once every two weeks. Mail is taken out by the phosphate ore carriers to Australia, New Zealand and Singapore.

As you read through this study, try to put yourself in the positions of each of the following three people:

- a geologist working for the phosphate commission on the island
- the wife of the geologist
- a schoolboy or schoolgirl visting the island during the summer holidays.

Approaching from the sea, Christmas Island presents a rugged and forbidding face of steep cliffs which range in height from 5 to 50 metres and are underworn and pitted by the ceaseless pounding of the breakers. The cliffs form a barrier all round the island, except for occasional small pebble beaches which in many cases are accessible only from the sea, as the cliffs occur immediately behind them.

Christmas Island is shaped like a T on its side.

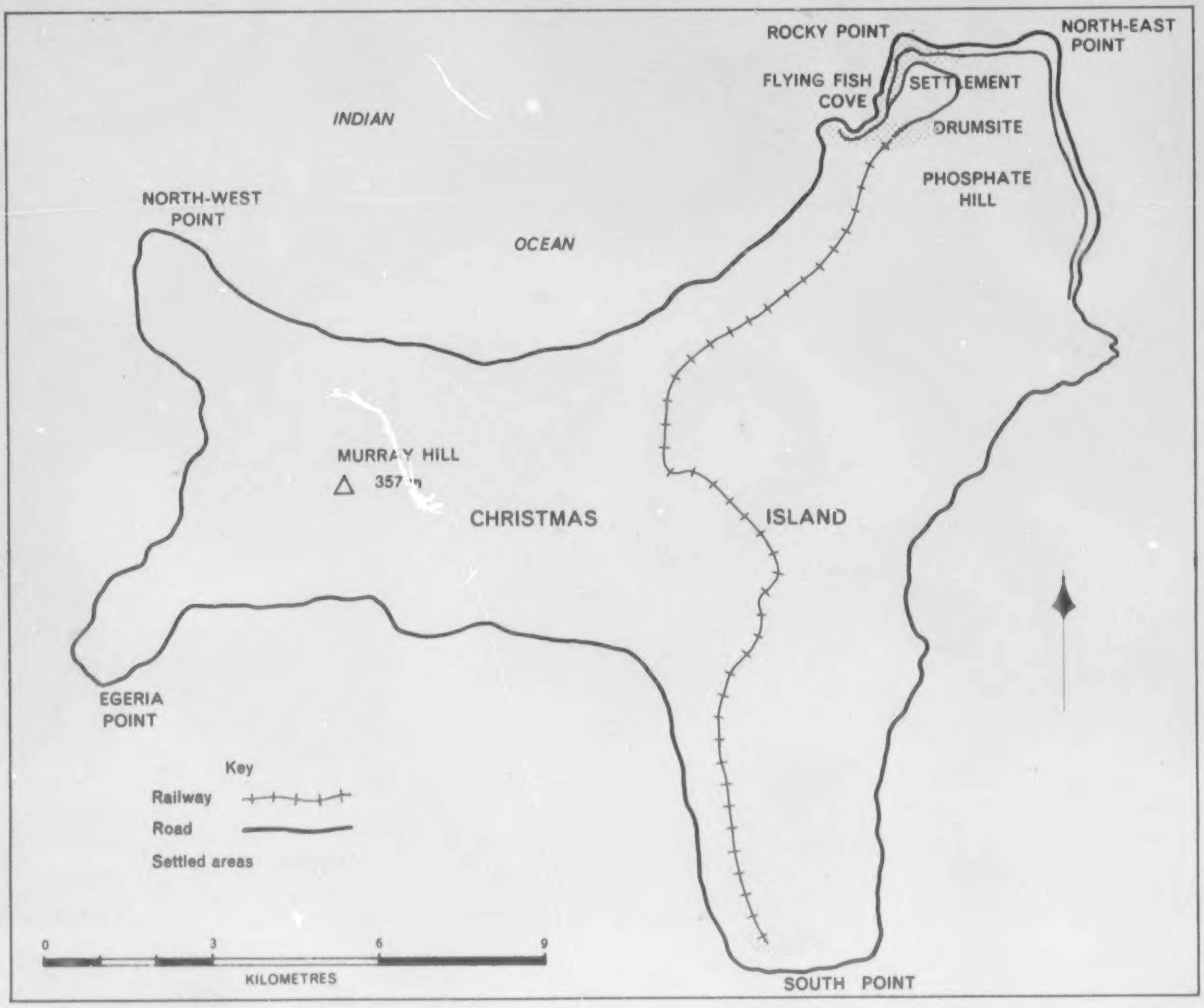

ROCKY POINT
NORTH-EAST POINT
FLYING FISH COVE
SETTLEMENT
DRUMSITE
INDIAN
PHOSPHATE HILL
NORTH-WEST POINT
OCEAN
MURRAY HILL
357 m
CHRISTMAS
ISLAND
EGERIA POINT
Key
Railway
Road
Settled areas
0
3
6
9
KILOMETRES
SOUTH POINT

Figure 8.2: Christmas Island

Roughly how large is it in square kilometres? The stem of the T runs from east to west and is 14·5 km long, while the cross-bar runs from north to south and is 18 km long. (See figure 8·2.) How high is the highest point on the island? Would you expect to find a coral reef at Christmas Island? (Refer to study 2 if in doubt.) Do you think this could be dangerous for ships as they approach the island? Compare figures 8·2, 8·3 and 8·4, and draw a diagram of Phosphate Hill as seen from a boat 3 km north-west of it.

Colonisation by many millions of sea-birds provided the guano source from which the phosphate deposits were ultimately created by chemical reaction with the island's limestone. All this resulted in the form the island shows today — high-grade phosphate pockets between coral limestone pinnacles, overlain by phosphatic soil on which a dense rain forest thrives. What is phosphate used for?

Why do people go to Christmas Island?

Although Christmas Island is remote and shows an inhospitable face to the Indian Ocean all around it, over 3,000 people live there. This is because the phosphate deposits developed over 20 million years are important to farmers in many places. Phosphate is converted by a simple chemical process called acidulation, into superphosphate, a high-grade fertiliser.

The history of the island is interesting. It was named Christmas Island by Captain William Mynors who sighted it on Christmas Day 1643, but no landing was made until William Dampier sent two parties ashore in March 1688. However, the island was to remain unclaimed and uninhabited for another 200 years, in spite of the fact that Dampier's men had discovered fresh water, stout timbers, and birds and crabs which made good eating. Since there was no indigenous population, John Clunies-Ross used it as a staging post for his ships between the Cocos-Keeling Islands and Java. Why should he want a deserted island for his ships? Various naval expeditions came to Christmas Island, but it was not until 1887 that the Royal Navy ship *Egeria* cruised off the island for ten days and sent various parties ashore to collect specimens of the flora and fauna and rock samples. On the *Egeria*'s return to England these rock samples were examined, and they were found to contain phosphate; thus in 1888 Christmas Island was formally added to the British Empire. George Clunies-Ross established a small settlement at Flying Fish Cove and in 1891 a ninety-nine year mining lease was granted to him and Sir John Murray; six years later the Christmas Island Phosphate Company (CIPC) was formed.

Since then phosphate has been continuously mined and shipped from Christmas Island with the exception of the years from 1942 to 1945 when the Japanese occupied the island. It was their intention to exploit the phosphate workings, but they only loaded two ships, both of which were torpedoed a few kilometres from Flying Fish Cove. Christmas Island has been a territory of the Commonwealth of Australia since 1 October 1958. Phosphate mining has been controlled and carried out by the British Phosphate Commissioners since 1948.

Everyone who lives on the island is in some way or other connected with the mining operation. Most of them are employed by the British Phosphate Commission (BPC) but there is also a small group of government employees, under the Administrator, controlling the schools, police force, post office and radio station. Altogether the population is about 3,000 persons — Chinese, Malays, Europeans and a few Indians. From which countries do you think these people would have come? What do you understand by the following terms: a 'multiracial society', and the 'ethnic

Figure 8.3: Aerial photograph of Christmas Island showing populated areas, Flying Fish Cove and the cantilevers. The smoke in the far distance is the dust from the dryers

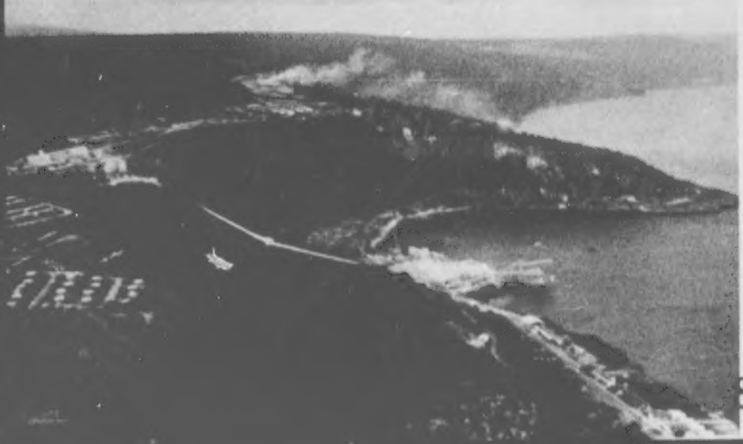
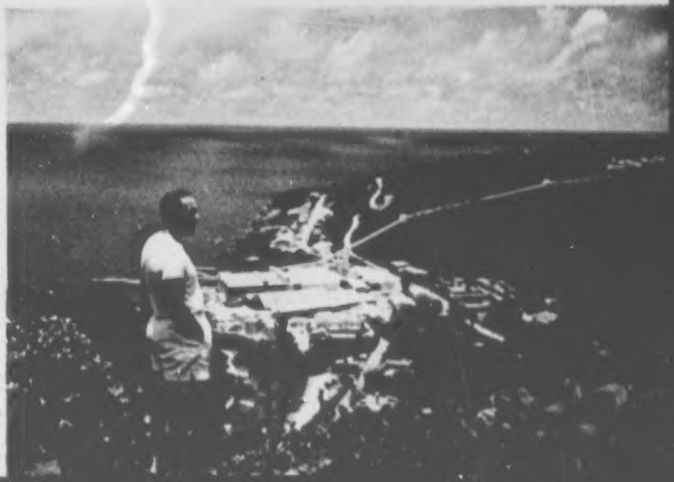
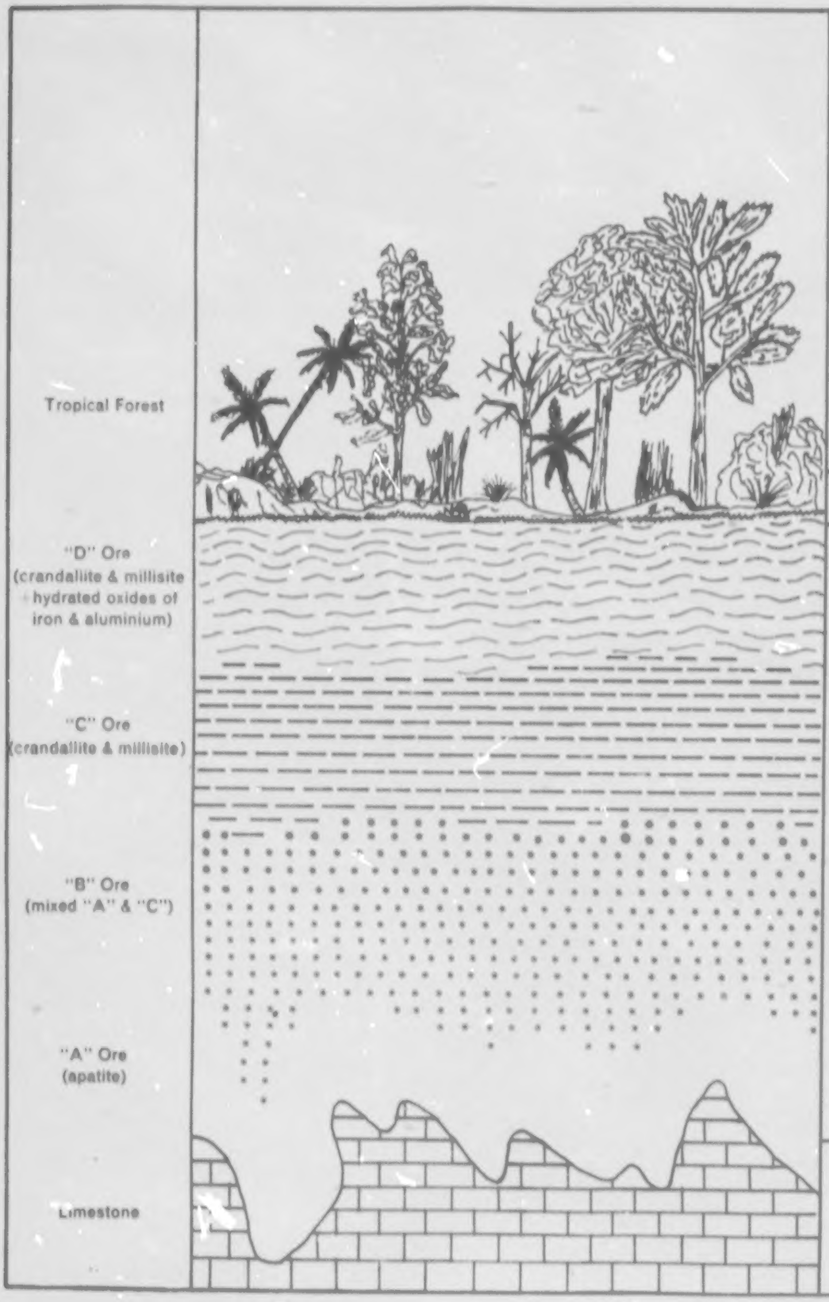


Figure 8.4: Christmas Island geologist looking over towards Flying Fish Cove, the cantilevers and the settlement area



origins' of a population? The island has a settled population of approximately 600 Cocos-Malays who represent the early work force brought in by the CIPC and the BPC. These people were transferred from the Cocos-Keeling Islands and are now established settlers on the island. Considering the numbers and varieties of racial groups living and working on the island, the population is unique in the sense that there is complete interracial harmony and the island has never in its history suffered from labour or racial discord.

It is also unusual in another sense, for some of the plants and animals (notably sea and land birds) found on Christmas Island are not found anywhere else in the world. Mammals are poorly represented: two species of native rat were once


Tropical Forest
"D" Ore (crandallite & millisite + hydrated oxides of iron & aluminium)
"C" Ore (crandallite & millisite)
"B" Ore (mixed "A" & "C")
"A" Ore (apatite)
Limestone

	Typical Range of Analyses of Ore Grades (%)		
	P_2O_5	CaO	Mixed Oxides $Fe_2O_3 + Al_2O_3$
"D" Ore	24.3	9.0	43.3
"C" Ore	28.7	9.8	44.2
"B" Ore	35.6	43.5	12.5
"A" Ore	37.1	50.5	3.5

Figure 8.5: Idealised profile of Christmas Island phosphate ores

abundant but have since disappeared, likewise a small shrew. The only native mammals remaining are two species of bats, a large fruit bat and a small insectivorous bat; these do not appear to be in danger of extinction, although the large fruit bat is caught and dried in thousands by the Chinese residents who export it to Singapore as an edible delicacy.

The phosphate ore body

Guano is the droppings of birds (or animals), and contains perhaps 4 per cent of phosphorus pentoxide. When leached by rain and seawater, or subjected to bacterial decay, some of the phosphorus is removed and reacts with the underlying soil or rocks to form phosphatic compounds. The chief guano-producing sea birds on Christmas Island are the boobies and frigate birds, which range widely over the surrounding oceans in their search for food. Thus these birds represent a means whereby phosphorus, which is common to marine life (in fish bones, for example), may be collected and deposited on the island; it has been calculated that a large bird colony is capable of accumulating millions of tonnes of guano over a period of only a few thousand years. This is believed to be the mechanism by which the phosphate deposits have accumulated on the island. There is no conclusive proof that sea birds were the source of the deposits, since no fossil bird remains have ever been found, but it is true to say that this theory best fits the known facts.

Phosphate deposits cover the entire island, and it should be noted that there is nothing on the island resembling a normal soil — phosphorus is always the main element. Refer to the idealised profile of Christmas Island phosphate ores (figure 8·5). Note that A grade ore is the highest quality and D grade is the poorest. What link can you see in the diagram between high-quality ores and depth for mining? What is the significance of the position of limestone in relation to the highest quality ores?

The mining operation

What is open-cast mining? (See figure 7·7.) Find two places on the mainland of Australia where it is practised.

Christmas Island phosphate is mined at the rate of 1,000,000 tonnes per year. The open-cast mining is a complex operation that requires extensive preparation. A mining field is marked out in the first place by extensive drilling. Gridlines are pushed through the jungle by bulldozers and surveyors, who are followed by large modern drilling machines (figure 8·6). Boreholes are drilled at fixed intervals and predefined grid spacings. Samples of the soil are collected through every 60 cm of depth and given a careful chemical analysis. From the results of this drilling the grades of ore are classified and located. When a mining field has been located beneath the phosphatic overburden, teams of bulldozers move into the area and systematic jungle clearing commences. Giant forest trees are felled and pushed aside. The next phase of the operation is termed stripping, and is conducted by large earth-moving scrapers which gather bowls of soil weighing 15 tonnes and carry this to selected areas where it is dumped in heaps. As the scrapers dig deeper, they expose the white-coloured phosphate rock which occurs in pockets between the limestone pinnacles. When the overburden has been stripped to the satisfaction of the geologist and mining engineers, large cranes with cable-operated grab buckets begin to dig out scoops of the phosphate rock and load it into heavy-duty haulage trucks. By systematic mining, a quarry face is formed at one side of the field and rapidly progresses backwards, leaving behind the bare, exposed limestone pinnacles. A mining field that has been thus completed is a spectacular sight, resembling a lunar landscape. See figures 8·7 and 8·8. Generally these mined-out areas remain free from secondary jungle growth, and ultimately an island that was once heavily forested will be bare. Little or no reclamation of spoiled areas is practised, since the overburden dumps themselves contain lower-grade phosphates that may eventually be extracted.

When a truck has been loaded with phosphate, it carries it away to a large stockpile situated beside the single-track railway line that runs from south to north across the island. From that point the phosphate is loaded by bucket-wheel excavators on to conveyor belts and into the rail hopper cars which carry it to the processing area. Phosphate is processed in large, oil-fired, rotating, inclined kilns called dryers. It is then stored in drybins for conveyor-belt dispatch down the hill to the ship-loading facilities (see figure 8·4). Ships are loaded by two huge swinging cantilevers over which the dried phosphate is carried by conveyors and discharged into the ships' holds at up to 3,000 tonnes per hour. Modern bulk carriers call at the island at regular intervals throughout the year to collect cargoes for delivery to Australia and New Zealand. What is a bulk carrier? Why is it better to carry minerals in bulk rather than in sacks?

At certain times of the year, generally between December and March, the ship-loading area in

Flying Fish Cove is subjected to the north-westerly monsoon. When this occurs, long ocean swells drive into the sheltered anchorage and ships are unable to berth beneath the cantilevers. At this time of year they are compelled to stand off the island and drift for periods of up to two months. Why is it that only these winds have these effects? In what ways could these winds be a nuisance to people living on the island? Christmas Island phosphate enjoys the reputation of being one of the cheapest phosphates in the world. What countries other than Australia produce phosphate? How far is the nearest one from Sydney by the most direct shipping route?

A process recently developed at the island accepts lower-grade phosphates and subjects them to intense wet scrubbing and screening to remove the waste and produce a higher-grade (beneficiated) phosphate that is combined and shipped with the mined phosphate. (To 'beneficiate' means to improve an ore's quality. Why is this done for low-quality ores before they are shipped?)

Life on the island

From its position and the photographs, what climate would you expect Christmas Island to experience? What is the latitude of Christmas Island? Compare it with the latitude on which you live, but remember that Christmas Island is a small island surrounded by water. Look at figure 8·9 and describe when the heaviest rainfall occurs. What is the total for the whole year? What sort of natural vegetation would you expect to find on Christmas Island from its temperatures and rainfall? Check with figures 8·7 and 8·8.

Examine table 8·1. Find out the same climate figures for your home area. Compare:

- Rainfall totals
- Rainfall distribution
- Mean temperature range
- Absolute maximum and absolute minimum temperatures.

Which place has the greater variation in humidity? Why is humidity measured as a percentage?

Examine figures 8·10 and 8·11. Why is it important on an island with such a high rainfall to keep close checks on surface water flow?

Living on Christmas Island, in spite of the isolation, is very similar to living in any small town in Australia. In fact, there is probably more to do on the island than in most small towns.

Perhaps the most popular pastime for all races is fishing. Malays are particularly fond of the sea and fishing, and most spare moments are spent out in their kolaks (small canoes with outriggers). Chinese and Europeans also follow this sport. Spanish mackerel (locally called tengeri), tuna, barracuda and a kind of sea bream are caught in large numbers. Swimming in two pools and snorkeling on the reef are enjoyed by many, and there are facilities for golf, cricket, football, bowls, tennis and badminton. Films are screened free at three outdoor cinemas four times per week, two nights in English and two nights in either Cantonese, Mandarin or Malay.

Table 8.1: Climate figures, Christmas Island

	RAINFALL (mm)	TEMPERATURE (°C) Max.	Min.	Mean	HUMIDITY (%) 1600 hours*
Jan.	221	31	24	27.5	70
Feb.	290	31	24	27.5	75
Mar.	272	31	24	27.5	74
Apr.	234	31	24	27.5	72
May	211	31	24	27.5	72
Jun.	160	30	24	27.0	72
Jul.	102	29	23	26.0	70
Aug.	51	30	23	26.5	68
Sep.	51	30	23	26.5	67
Oct.	56	31	23	27.0	68
Nov.	185	31	24	27.5	71
Dec.	191	31	24	27.5	70

Highest temperature ever recorded: 35°C
Lowest temperature ever recorded: 19°C

Source: Compiled from recordings taken 1902-52 for Meteorological Office, Air Ministry, and taken from *Eastern Archipelago Pilot*, Vol. IV, 1953, Hydrographic Dept, Admiralty, London

* The 24-hour clock is used for recordings to be taken at set times around the globe. It is also used by international airlines. What is meant by 0130 hours, 0600 hours, 1320 hours, 1945 hours, 2359 hours?

There are four schools — two primary, one secondary and one new technical school — to cope with the children of employees, and one modern forty-bed hospital for medical care. In addition to providing medical care for island residents, BPC provides a dentist, an infant welfare clinic and all the services usually given by a city or town council — roads, drains, electricity, telephones, rubbish disposal and bus services. The company trade store supplies all the everyday needs that your local supermarket would stock, and a few Chinese and Malay traders deal in duty-free goods from Singapore.

Island residents enjoy a high standard of living, and for a community so isolated and remote are well catered for in a highly developed and complex society.

Christmas Island's links with the world

You have seen that many races live on Christmas Island; thus its links with the rest of the world

Figure 8.6: Drillers at work

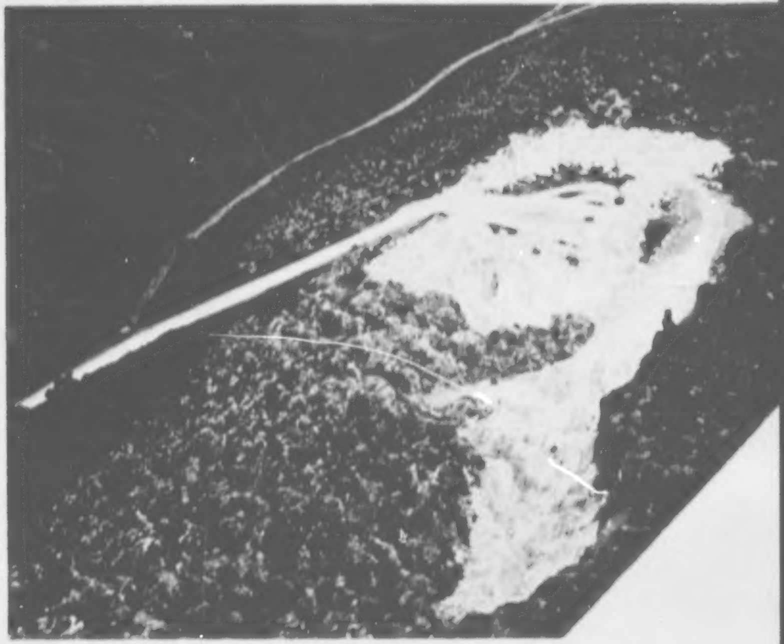
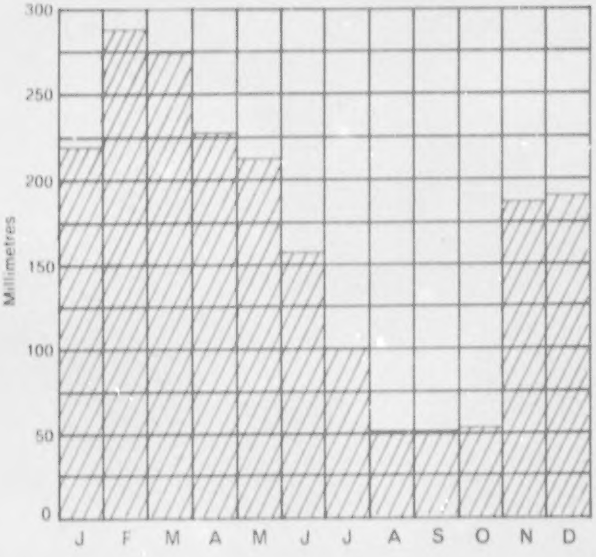
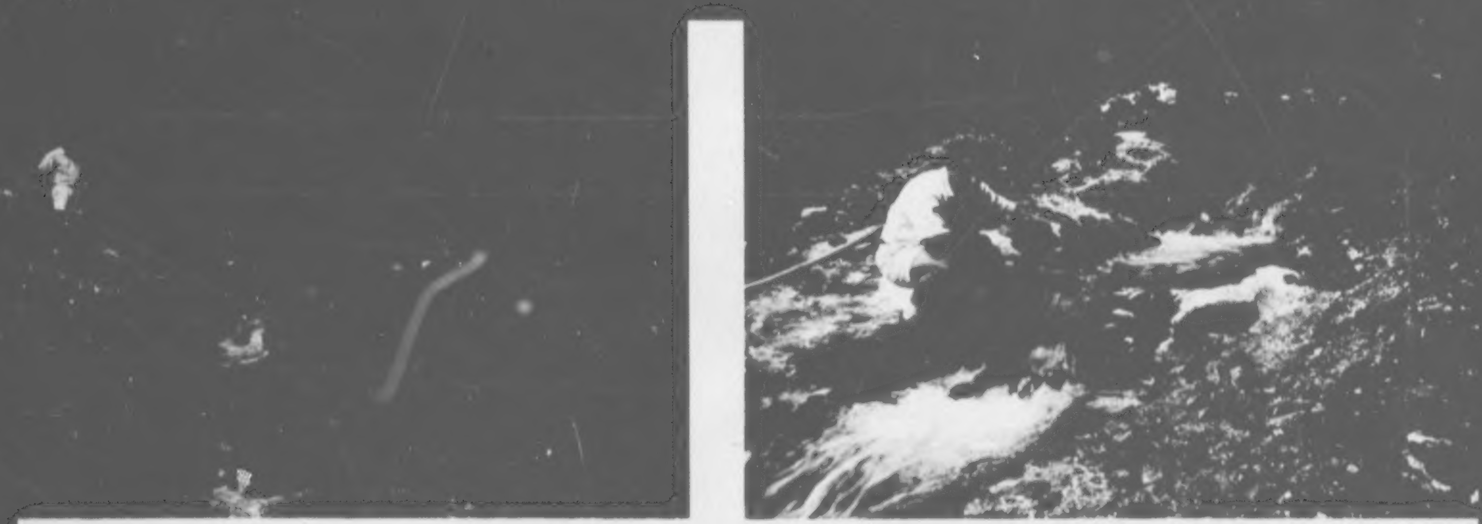


Figure 8.7: Aerial photograph of Christmas Island mining area showing recently quarried limestone area (white-cream); previously mined phosphate field (dark grey); cleared ground (smooth green); primary rain forest (tall green trees)

Figure 8.8: Aerial photograph of Christmas Island showing recently mined phosphate field, original forest and mining roads

Figure 8.9: Rainfall distribution chart





Figures 8.10 and 8.11: Measuring surface water flow

are forged firstly by the residents, and secondly by the destination of the phosphate. From the island, ore carriers take the phosphate mainly to Australia and New Zealand, by the 20,000 tonne load on average. The fertiliser companies then treat the raw phosphate rock with sulphuric acid to make superphosphate. Phosphate is a primary plant food; in the form of superphosphate it is soluble, and can be used extensively by Australian and New Zealand farmers on their land.

Phosphate has been shipped from Christmas Island for the past seventy years, and obviously a great deal of the better-grade ore has now been used up. There are extensive reserves of lower-grade ore which can be utilised with processing. B grade ore when washed and screened is brought up to the required phosphate content of 36.5 per cent, and at present research is under way on C grade ore to extract the alumina content for processing into aluminium and to use the remaining phosphate as fertiliser.

Of the 3,500,000 tonnes of phosphate required annually by Australia and New Zealand, Christmas Island supplies 1,000,000 tonnes. Nauru provides 2,000,000 tonnes, Ocean Island 500,000 tonnes and the balance is made up by stocks imported from Florida, Togoland and Senegal.

Many millions of tonnes of high-grade phosphate have been shipped from Christmas Island. The potential is many times greater, but has still to be developed. Do you think that the removal of the phosphate from the island is unwise? What are the main arguments in favour and against?

What will happen to the island when it is no longer economic to go on mining phosphate? Try to find out more about the future of other similar islands, for example Nauru.

FURTHER ACTIVITIES

Now that you have studied Christmas Island's phosphate production, be prepared to give your class a short talk and discuss amongst yourselves one of the three roles mentioned at the beginning of the study. Suggested points are:

- The decisions I had to take as the geologist in charge of the opening up of a new mining area (reread page 76)
- The different type of home life for the wife of a geologist on Christmas Island
- Holiday time on Christmas Island has more to offer than staying in my home town (think carefully here!).

Figure 8.12: School train leaving South Point

Using a diagram, describe the typical island system. Would this differ if the island was very large or very small?

How would you encourage people to go and work on a remote small island such as Christmas Island?

9

The industrial system: a bakery

Another system which geographers analyse is the industrial system. This one is far more complicated than either the mining system or the farming system. For a start, the industrial system usually involves a wide range of raw materials — inputs — all of which should be costed and balanced against each other to try to identify the most suitable location for a factory. The amount and range of specialisation for the work force is far greater in a factory than in any mine or on any farm. Labour has to be carefully recruited, trained, organised, and then encouraged to stay in that particular industry. As new ideas develop, so too the market can change very quickly. Dresses or suits that are made today can be out of fashion tomorrow. An industry needs to locate itself where it can supply its market readily, but this is not always easy if its raw materials are heavy, as in the iron and steel industry. If you were the owner of a timber mill, where would you locate your business? Suppose you produced icecream in your factory — where would you go then? Name two industries that are located right beside their raw materials. Now name two that are located beside their market. Look at figures 9·1-9·5 and for each explain why the industry is located where it is.

It is, perhaps, easiest if we look at several sample industries to see how some of these factors work. The ones we have chosen are all called service industries. By this we mean industries that provide services direct to the customer.

A BAKERY

Have you ever tried to make your own bread? If you live on a sheep or cattle station, far from the nearest baker, you may be an expert, but if you have never experimented, why not try now?

It is possible to buy dried yeast in large towns. This will keep for a long time in an airtight container. To revive it, mix together:

3 teaspoonfuls dried yeast
1 teaspoonful plain flour
1 teaspoonful sugar
2 tablespoonfuls water at 60°C

and allow to stand a few minutes. For the bread, mix:

720 g flour
30 g sugar
30 g salt
30 g butter
360 ml water, warm enough to bring the mixture to a temperature of 26-27°C.

Knead the mixture into a dough and leave it in a plastic bag in a warm place for twenty to thirty minutes. In this time it should double its size. At this stage you divide it into cooking units: for the beginner, it is easier to make rolls than a loaf of bread, and these quantities should make about a dozen rolls. Leave the small pieces of dough until they double in size again — another twenty to thirty minutes — keeping them somewhere near a temperature of 27°C. Meanwhile, heat the oven to 260°C. Bake the rolls for twenty-five minutes or a whole loaf for forty-five minutes. Tap the rolls gently: if they sound hollow, they are done.

Now that you have enjoyed your own bread, and incidentally passed a test for the Venture Scouts' Master Cook badge, think again of the things that were involved. You collected the ingredients or *raw materials*, some like water from near home but others from places further away, involving *transport* arrangements to get them to your kitchen. Your kitchen, as a bread *factory*, needed to be kept at a suitable temperature, and you needed *apparatus* such as a container to mix your dough and an oven to cook it in. Then there was gas or electricity or wood to *heat* the oven, and someone, in this case yourself, to do the *work*. Finally, if your product was good, you had *consumers*, and if there had been a surplus of rolls you might have been able to sell them at a profit.

If we look now at bread making on a commercial scale, indeed at any processing industry, we see the same elements in the operation — raw materials, transport, factory, source of energy, labour, and a consumer market. Small-scale bread making for a country town in some cases

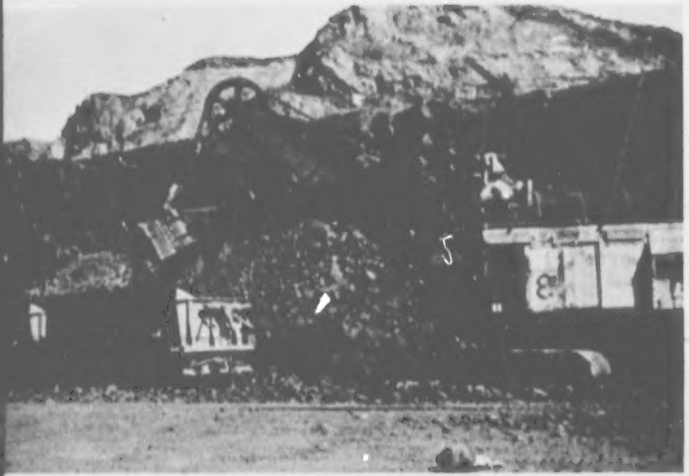


Figure 9.1: Mining iron ore at Iron Knob, S.A.

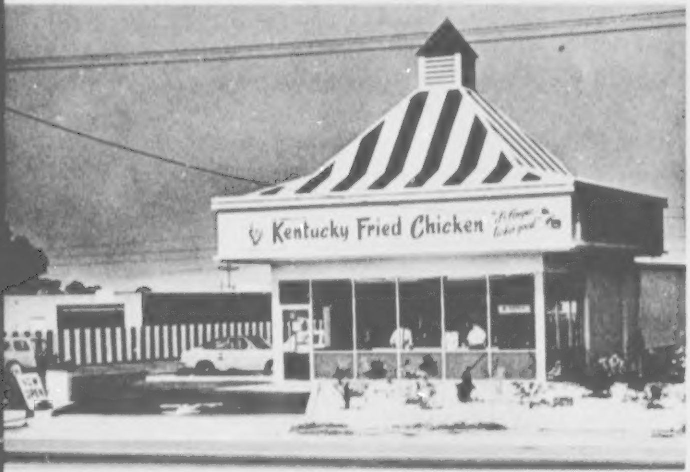


Figure 9.2: A 'take-away' food outlet in a Melbourne suburb

Figure 9.4: BHP iron and steel works, Newcastle, N.S.W.

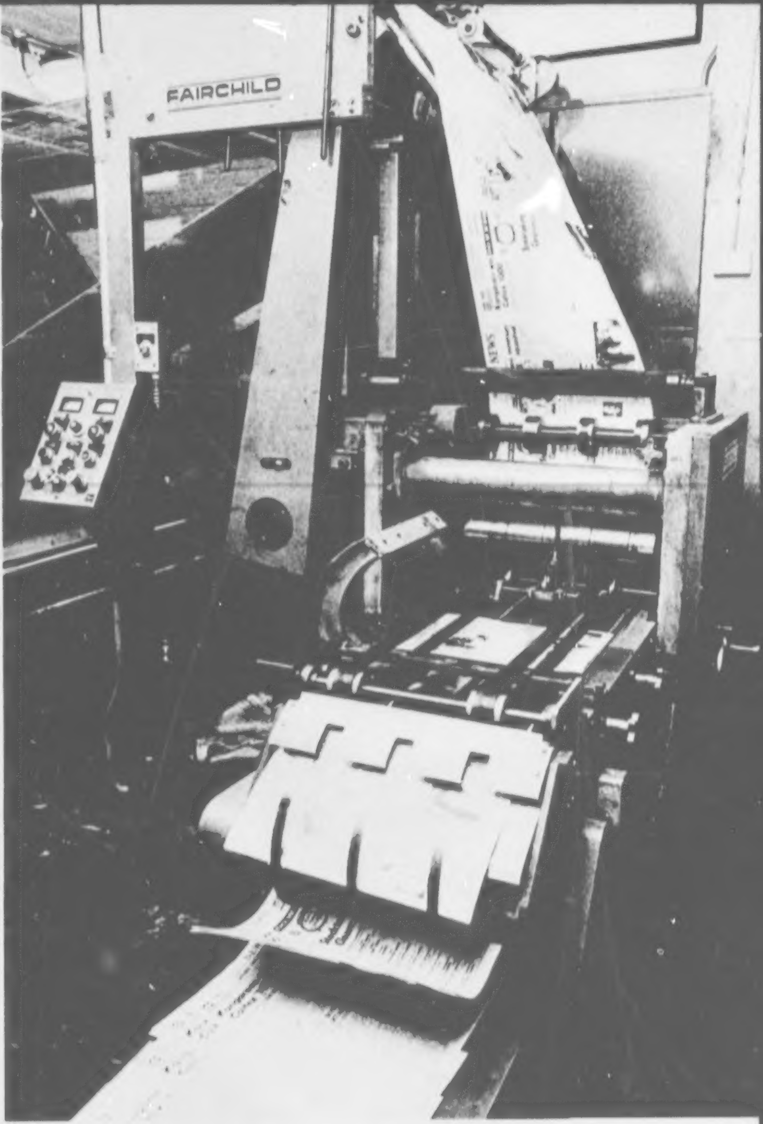
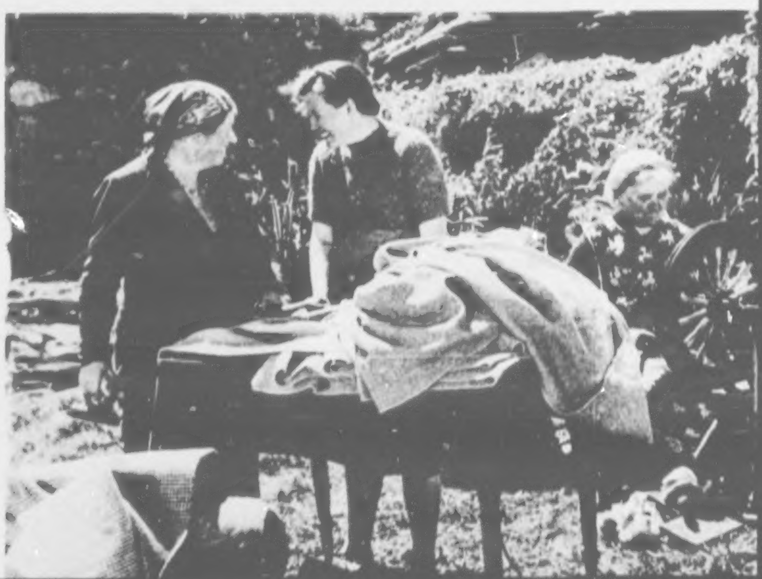


Figure 9.3: Printing a suburban newspaper in Sydney

Figure 9.5: Cottage industry in the Outer Hebrides, Scotland — spinning yarn for Harris tweed, and pressing the finished fabric with a flat-iron

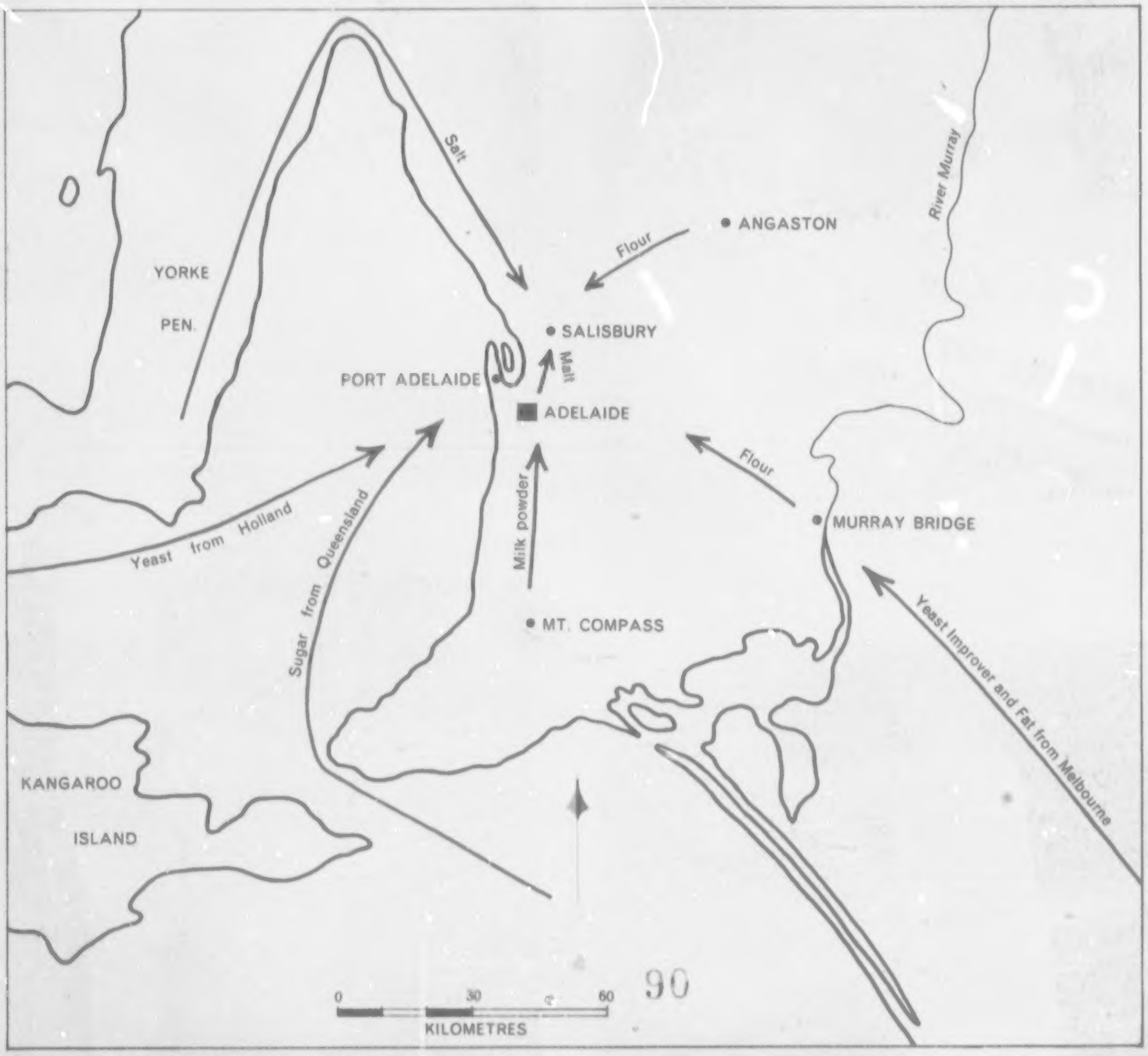


still follows, though with larger quantities, the hand-mixing and oven-baking processes which you tried in the kitchen. In towns, however, the industry uses expensive machinery. A large rotary oven, for example, might easily cost $35,000. If the baker borrowed money at 7 per cent interest in order to buy such an oven, his interest bill would be $2,450 a year, which would have to be paid from his profits. It is obvious then that he would need to sell daily a very large quantity of bread in order to make his business pay. A large machine, however, is economical in its use of labour; and labour costs are high in Australia. With these considerations in mind, let us look closely at one example — Opie's North Bakery Pty Ltd, which has its headquarters in Salisbury, South Australia, and supplies the town of Elizabeth, among other areas. We shall need to remember that it is not the only bread supplier, nor even the largest in this district.

Raw materials

The best flour for bread comes from hard wheat with a high protein value, normally produced in the drier wheat growing areas; soft wheat is used for biscuits. Opie's get flour from three separate mills at Salisbury, Angaston and Murray Bridge, and blend them to give the 11 per cent protein content necessary for bread. Compressed yeast, looking like cakes of greyish-white soft soap, is imported from Holland, because this is cheaper than buying Australian yeast. Why should this be so? A yeast 'improver', to slow down the fermentation and keep the dough to a workable consistency, is also used: this is made in Melbourne. Milk powder, specially prepared for the purpose, comes from a factory at Mount Compass, 65 km south of Adelaide, and fat to give the bread keeping qualities and make it easy to slice is brought from Victoria. Salt from southern Yorke Peninsula, malt manufactured in Adelaide, and Queensland sugar,

Figure 9.6: Sources of raw materials for bread


Salt
ANGASTON
Flour
River Murray
YORKE
PEN.
SALISBURY
Malt
PORT ADELAIDE
ADELAIDE
Flour
MURRAY BRIDGE
Yeast from Holland
Sugar from Queensland
Milk powder
MT. COMPASS
Yeast Improver and Fat from Melbourne
KANGAROO
ISLAND
0
30
60
KILOMETRES

refined at Port Adelaide, are also used. Copy the map in figure 9·6, and using your atlas work out approximately how far each of the ingredients has to travel to Opie's bakery. The quantities used for each 68 kg bag of flour are these:

Water	37·8 litres
Salt	1·36 kg
Fat	0·90 kg (variable with type of bread; more in Vienna loaves)
Yeast	0·57 kg
Milk powder	0·34 kg
Yeast improver	0·34 kg
Sugar	0·23 kg (0·90 kg in Vienna bread)
Malt	0·23 kg (in some varieties only)

Compare these with your experimental bread recipe and note any differences.

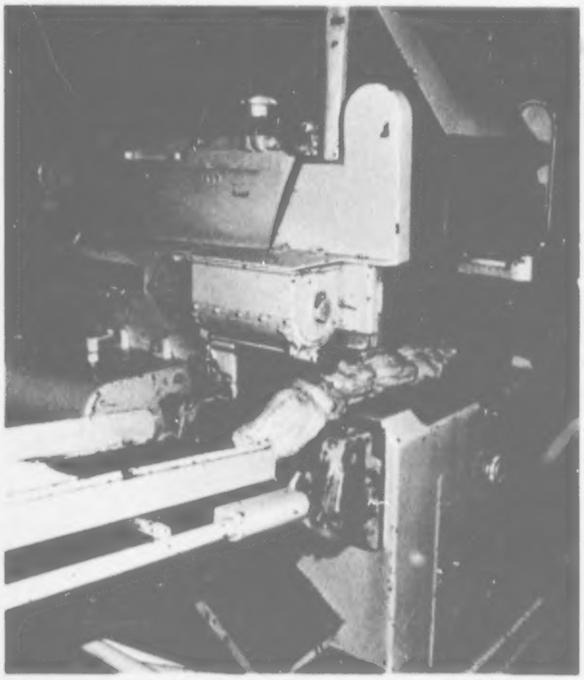


Figure 9.9: The 'divider' which cuts bulk dough into loaf-sized pieces

Figure 9.10: Removing loaves from the oven

Figure 9.7: Mixing the ingredients

Figure 9.8: Mixing with water

Figure 9.11: Hot loaves in racks to cool

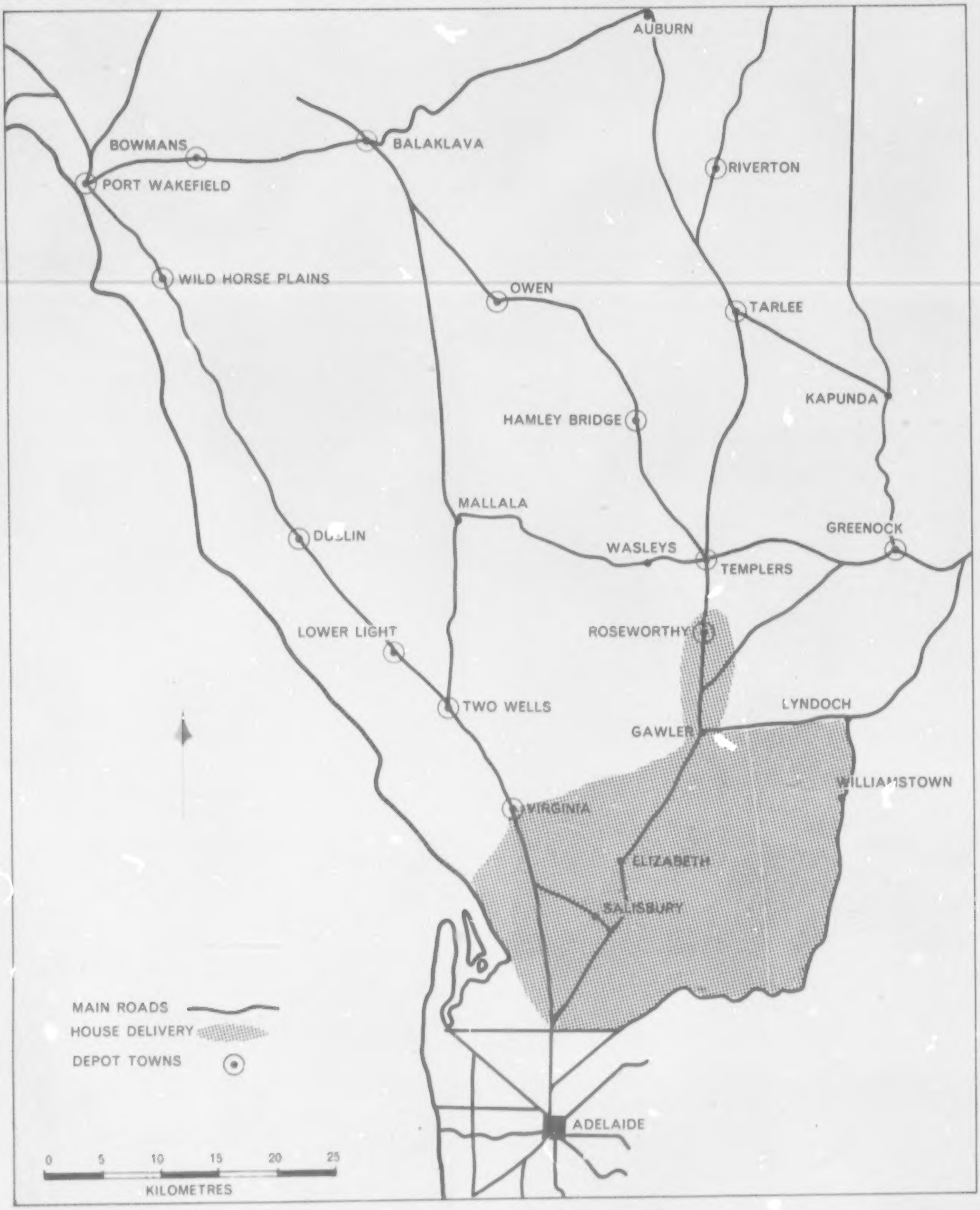

AUBURN
BOWMANS
BALAKLAVA
RIVERTON
PORT WAKEFIELD
WILD HORSE PLAINS
OWEN
TARLEE
KAPUNDA
HAMLEY BRIDGE
MALLALA
DUBLIN
GREENOCK
WASLEYS
TEMPLERS
LOWER LIGHT
ROSEWORTHY
TWO WELLS
LYNDOCH
GAWLER
WILLIAMSTOWN
VIRGINIA
ELIZABETH
SALISBURY
MAIN ROADS
HOUSE DELIVERY
DEPOT TOWNS
ADELAIDE
0
5
10
15
20
25
KILOMETRES

Figure 9.12: Distribution of bread

The factory

Work at the bakery starts at about 1 a.m. Flour, water, yeast, salt, and any other ingredients needed for the type of bread being made, are mixed together to form a dough. The mixing time varies from thirty minutes at low speed to five or six minutes in a high-speed mixer. The dough is then allowed to stand for about three hours in large bowls each holding about 360 kg.

During this time the fermenting yeast produces carbon dioxide gas which causes the dough to double its size and to become spongy in texture. During this process the air must remain moist and at a temperature of 26-27°C. Opie's bakery has radiators on the walls, and thermometers are checked frequently. 'See-through' doors of thick plastic hang at the doorways to reduce draughts.

The dough is next cut by a machine into pieces of the weight required for each loaf, and allowed to stand again until each piece fills the loaf-sized tin in which it has been put. These tins are loaded on to shelf-like trays which move on a conveyor belt through an oven chamber 20 metres long, heated to 260°C by burning oil. The baking takes about forty minutes. Hot loaves are stood in racks to cool; then, if required, they are cut and wrapped by a machine. See figures 9·7-9·11.

Distribution to customers

Bread is delivered on a house-to-house basis within a radius of about 15 km. For this purpose, 28 vans are used, each with its own driver who has 180 to 200 house customers as well as the shops in his area. Four supervisors and a bread-room staff of four men are also part of the distribution pattern. Beyond the household delivery area, bread is sent out to depots (that is, country stores with a bulk order for their own distribution). The delivery network is shown in figure 9·12. Unsold bread from the vans is brought back to the bakery and is sold as stale bread to poultry farmers to feed fowls.

Figure 9·13 shows the complicated organisa-

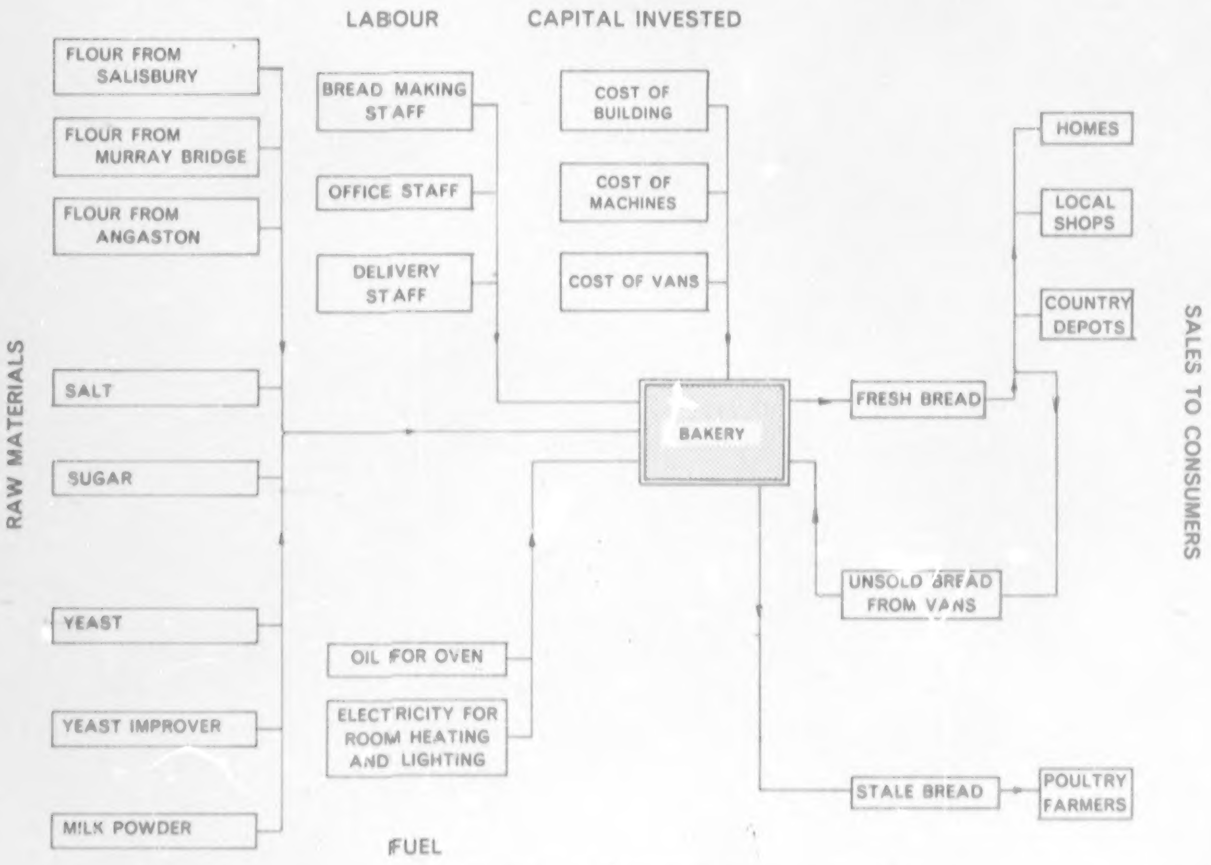

LABOUR
CAPITAL INVESTED
RAW MATERIALS
FLOUR FROM SALISBURY
FLOUR FROM MURRAY BRIDGE
FLOUR FROM ANGASTON
SALT
SUGAR
YEAST
YEAST IMPROVER
MILK POWDER
BREAD MAKING STAFF
OFFICE STAFF
DELIVERY STAFF
COST OF BUILDING
COST OF MACHINES
COST OF VANS
BAKERY
OIL FOR OVEN
ELECTRICITY FOR ROOM HEATING AND LIGHTING
FUEL
FRESH BREAD
HOMES
LOCAL SHOPS
COUNTRY DEPOTS
UNSOLD BREAD FROM VANS
STALE BREAD
POULTRY FARMERS
SALES TO CONSUMERS

Figure 9.13: The bakery pattern

tion needed to bring a loaf of fresh bread to our homes in the morning. You may like to try to make similar patterns for a butcher or a greengrocer.

Costs

Finding out what part of the cost of a loaf of bread comes from each of the factors shown in figure 9·13 is much harder than it looks. For example, we can find out what the factory pays for raw materials and wages. Yet the amount paid for flour is itself partly the cost of raw material (wheat) and partly other things (wages in the flour mill and interest on mill machinery, for example). Similarly we know what the bakery pays for transport (delivery of bread), but transport costs are also involved in moving wheat to the flour mill or flour to the bakery. The diagrams in figure 9·14 therefore are costs to the bakery as a unit. Things like light, fuel, interest on borrowed money and office costs other than wages are grouped together and known in business as 'overheads'. They do not vary as much as costs of materials or wages when the quantity of bread made is increased or decreased.

In figure 9·14 (a), the cost of a loaf of bread is divided between manufacturing, office expenses and selling expenses. In figure 9·14 (b) it is divided between materials, wages, transport and overheads. Draw a large copy of figure 9·14 (a) and use table 9·1 to show on it in addition the information given in figure 9·14 (b).

The average bakery might receive for its bread 5 per cent more than the cost of production, and out of this it would pay tax. The remainder is its profit.

How much does a 1 kg loaf of bread cost in the shops now? Estimate the *total* cost of making your own loaf of bread, using the procedure shown on page 80. Don't forget to include cost of heating and use of machinery. If you include the cost of paying yourself, your home-made loaf would cost many times more than the bakery loaf. This shows that the industrial system, in the bakery industry and many others, is many times more efficient when working on a large scale. What other 'economies of scale' can you think of?

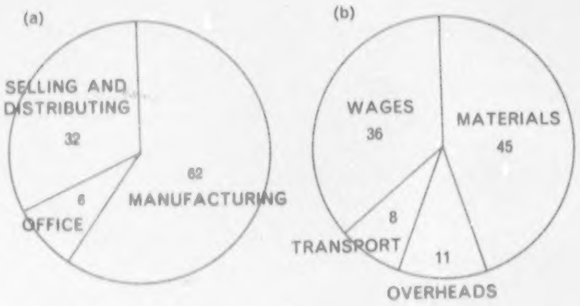


Figure 9.14: Bread-making costs as percentages

Table 9·1: Percentage costs of bread making

Manufacturing:	
Materials	45
Wages	13
Overheads	4
Office:	
Wages	2
Overheads	4
Selling and distribution:	
Transport	8
Wages	21
Overheads	3

10

Newspaper delivery, Portland

EFFECT OF COMPETITION AND DISTANCE ON DISTRIBUTION OF THE LOCAL NEWSPAPER IN THE PORTLAND AREA

In an industrial system, there will be interchange of goods between producing and market areas. Often this will lead to competition between two producing areas.

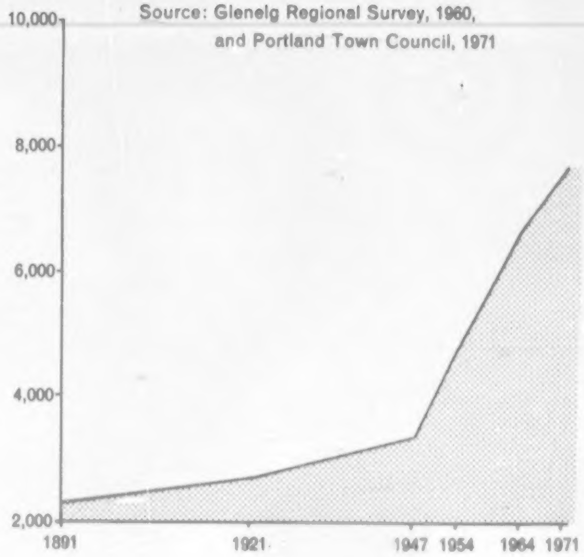
The newspaper provides people with a link between themselves and areas which in days gone by were very remote. Today, most local newspapers provide information mainly about the immediate area, and as a result they do not have a large circulation. Look at figures 10·1 and 10·2 and attempt to determine what relationship exists between the population and the newspaper circulation.

The rise in circulation figures has, of course, not only come about because of a rising population, but also through changing methods of news collection, printing techniques, and avenues of distribution. In the last century, news was collected locally as a result of isolation through distance. Most of the contributions in the paper were letters to the editor and reports of occurrences in the town and district of Portland only.

Modern communication now allows the Portland *Observer* to print news from any part of Australia with little delay. Distance, then, was the key factor in the amount and variety of news that was printed from week to week. Look at figures 10·3, 10·4 and 10·5, and using the information you have just considered regarding news collection, try to explain why the distribution of newspapers is as shown on the maps.

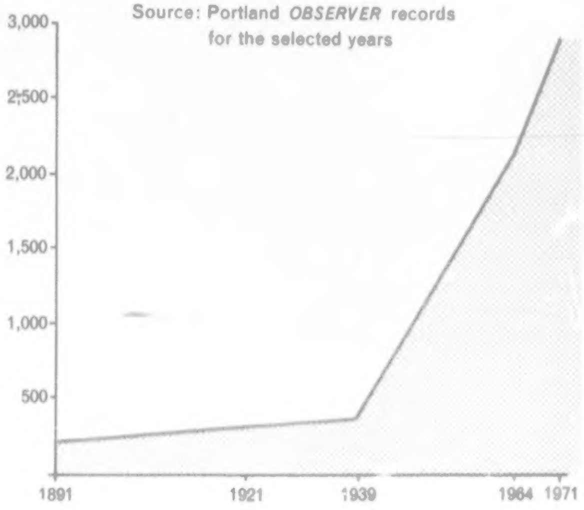
During the period 1891-1939 there were other newspapers which were distributed throughout the area. Thus figure 10·4 shows the influence of other newspapers in the area. Consult figure 10·2, look at the maps in figures 10·3 and 10·4, and try to determine the reason for the relatively low circulation increase from 1891 to 1939.

During the 1960s, the Portland *Observer* was taken over by the company owning the Hamilton



Source: Glenelg Regional Survey, 1960, and Portland Town Council, 1971

Figure 10.1: Population of the town of Portland, 1891-1971



Source: Portland *OBSERVER* records for the selected years

Figure 10.2: Newspaper circulation in the town of Portland, 1891-1971

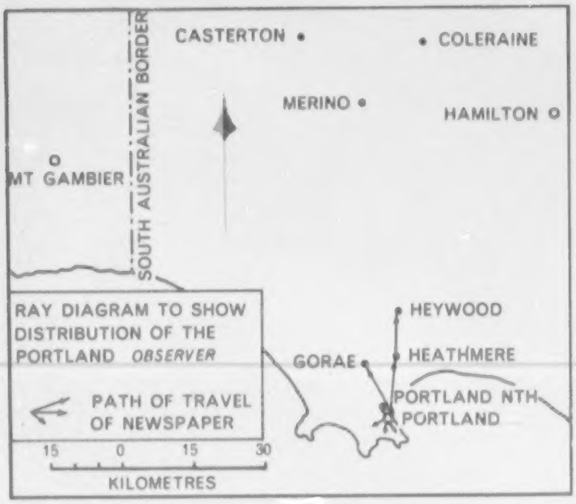

CASTERTON
COLERAINE
MERINO
HAMILTON
MT GAMBIER
SOUTH AUSTRALIAN BORDER
RAY DIAGRAM TO SHOW DISTRIBUTION OF THE PORTLAND OBSERVER
PATH OF TRAVEL OF NEWSPAPER
HEYWOOD
GORAE
HEATHMERE
PORTLAND NTH
PORTLAND
15 0 15 30
KILOMETRES

Figure 10.3: Distribution of newspapers, 1891

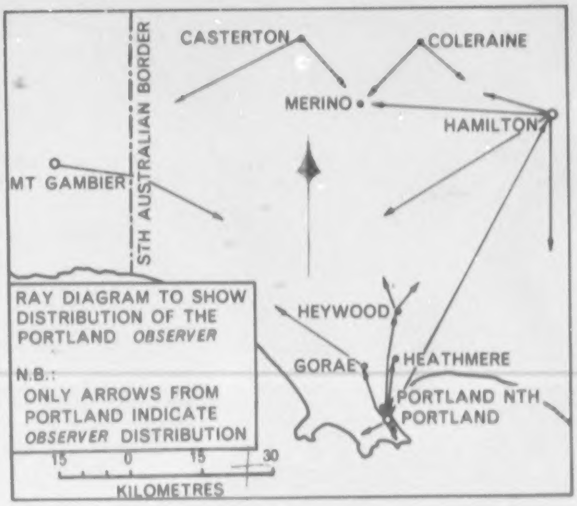

CASTERTON
COLERAINE
MERINO
HAMILTON
MT GAMBIER
STH AUSTRALIAN BORDER
RAY DIAGRAM TO SHOW DISTRIBUTION OF THE PORTLAND OBSERVER
N.B.: ONLY ARROWS FROM PORTLAND INDICATE OBSERVER DISTRIBUTION
HEYWOOD
GORAE
HEATHMERE
PORTLAND NTH
PORTLAND
15 0 15 30
KILOMETRES

Figure 10.4: Distribution of newspapers, 1939

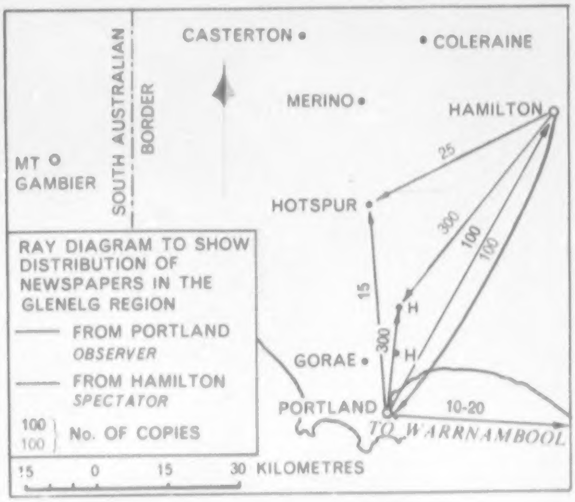

CASTERTON
COLERAINE
MERINO
HAMILTON
MT GAMBIER
SOUTH AUSTRALIAN BORDER
HOTSPUR
25
300
100
100
15
H
300
H
GORAE
PORTLAND
10-20
TO WARRNAMBOOL
RAY DIAGRAM TO SHOW DISTRIBUTION OF NEWSPAPERS IN THE GLENELG REGION
FROM PORTLAND OBSERVER
FROM HAMILTON SPECTATOR
100 100 No. OF COPIES
15 0 15 30 KILOMETRES

Figure 10.5: Distribution of the Portland Observer and other competing newspapers in the area, 1971

Table 10·1

Audit Period	No. of Copies	Tri or Bi-weekly
Apr.-Sep. 1967	3,215	bi-weekly
Oct.-Mar. 1968	3,143	"
Apr.-Sep. 1968	2,707	tri-weekly
Oct.-Mar. 1969	2,609	"
Apr.-Sep. 1969	2,746	"
Oct.-Mar. 1970	2,885	"
Apr.-Sep. 1970	3,037	"
Oct.-Mar. 1971	2,946	"

Table 10·2

Audit Period	No. of Copies	Price
Oct.-Mar. 1970	2,886	5c
Apr.-Sep. 1970	3,037	5c
Oct.-Mar. 1971	2,946	7c

Spectator. In the previous five years the two papers had been in competition with each other in the area between Portland and Hamilton. Look at figure 10·5 and try to determine where the circulation figures are about equal. Geographers refer to this point as a *break-even point*.

Other factors affecting distribution

Number of issues per week

Consult the figures in table 10·1 and attempt to determine the effect of changing from a bi-weekly paper (two issues per week), to a tri-weekly (three issues per week).

Price of the paper

Examine the figures in table 10·1 again. The information in table 10·2 may help you to ascertain why the distribution tended to fall off after October 1970.

FURTHER ACTIVITIES

As a class exercise, you might attempt to find out about the distribution of your own local newspaper; using the work in this chapter as a guide, try to discover whether the same factors affect its distribution.

As a further extension of the work, you might like to survey a local radio or television station and attempt to determine what factors will affect their listening or viewing areas. Are the factors which decide the distribution similar to those for newspapers?

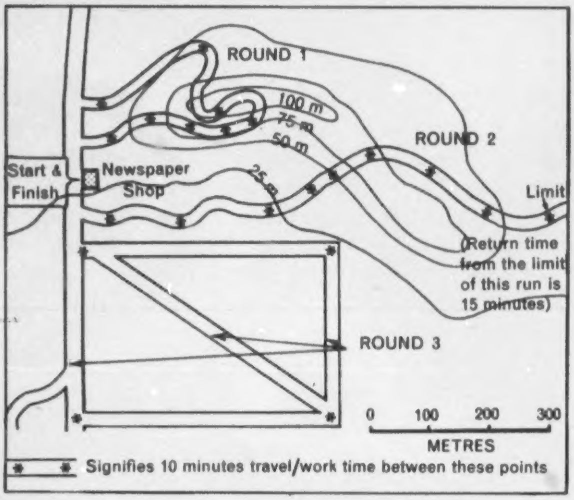

ROUND 1
100 m
75 m
50 m
25 m
ROUND 2
Start & Finish
Newspaper Shop
Limit
(Return time from the limit of this run is 15 minutes)
ROUND 3
0
100
200
300
METRES
Signifies 10 minutes travel/work time between these points

Figure 10.6

THE DELIVERY OF NEWSPAPERS: A TIME/DISTANCE STUDY

Refer to figure 10·6. Each round delivers to approximately the same number of houses. These are distributed evenly on both sides of the road. As bicycles are not provided on these rounds, newspaper boys deliver to both sides of the road as they progress.

Estimate the time it will take to deliver to each round and return to the newspaper shop.

Estimate the distance covered on each round.

Which paper delivery round would you choose to work on? Why?*

Which round would be hardest on a bicycle?*

Would you go clockwise or anticlockwise on Round 1? Why?*

Is the shop located in the best position for supplying papers to these three rounds?

**To answer these questions, you may need to refer to the question on page 12 which tells you more about slope on a map.*

This exercise is called a time/distance study. The link between time and distance is an important one, and you will find more about it in the activities on page 98 and in the Sale study (p. 117).

11

A garage: 'the repair shop'

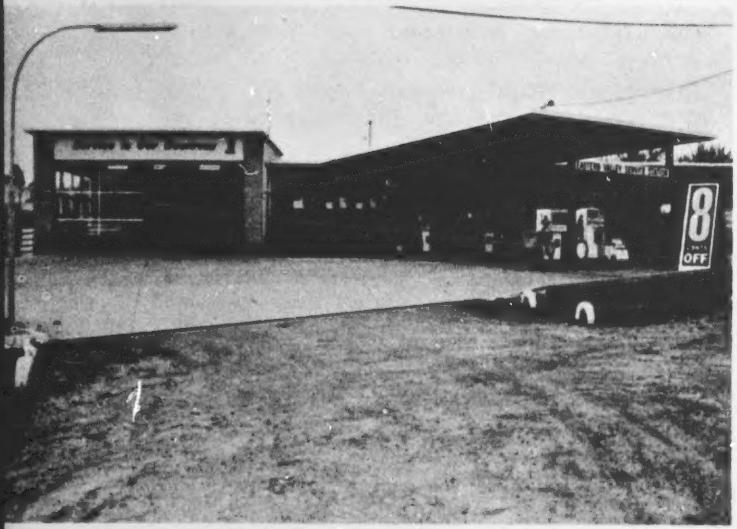


Figure 11.1: Looking towards the service station from Doncaster Road

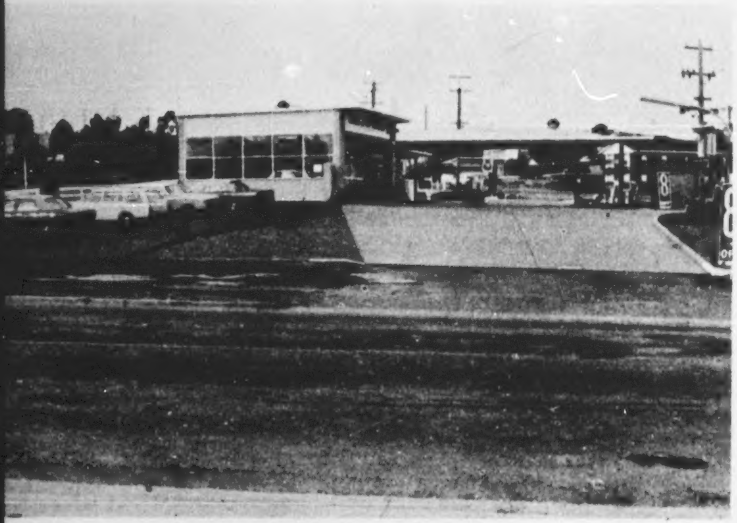


Figure 11.2: Looking towards the service station from High Street

Have you ever looked carefully at a service station? Do you know what a service station is? Over twenty years ago, the name 'service station' hardly existed; those places where people bought petrol were called garages. Make a list of the things which you think happen at a modern service station. What sort of land use would you call this?

Figures 11·1, 11·2 and 11·3 show a service station in the Melbourne suburb of Doncaster, and figure 11·4 is a map of the block of land occupied by the service station. Shade on the map the part of the site that is covered by the service station building.

Look at figures 11·5, 11·6 and 11·7 — photographs and a map of the site of an older garage in the Melbourne suburb of Hawthorn. Shade on the map the part of the site that is covered by the garage building.

When you examine the two maps and the photographs, what differences can you see in the way the modern service station owner uses the land (*site*) compared to the older garage?

Examine figure 11·8. This is a very special map. It reveals the approximate location of each of the *known* customers (shown by x) of the service station, and of the *known* customers (shown by ●) of the garage. Figure 11·9 shows the major roads between the service station and the garage, and their customers.

On figure 11·8, draw a straight line from each of the service station's customers to the service station, and from each of the garage's customers to the garage. Is there any difference in the shape and the size of the customer area of the service station and of the garage? Which has the larger number of known customers?

There is one important difference between the service station and the garage which hasn't been mentioned yet. The service station has a large number of customers whose addresses the proprietor does not know. In fact, the proprietor thinks that those customers whose addresses he does know are only about one-fifth of his regular

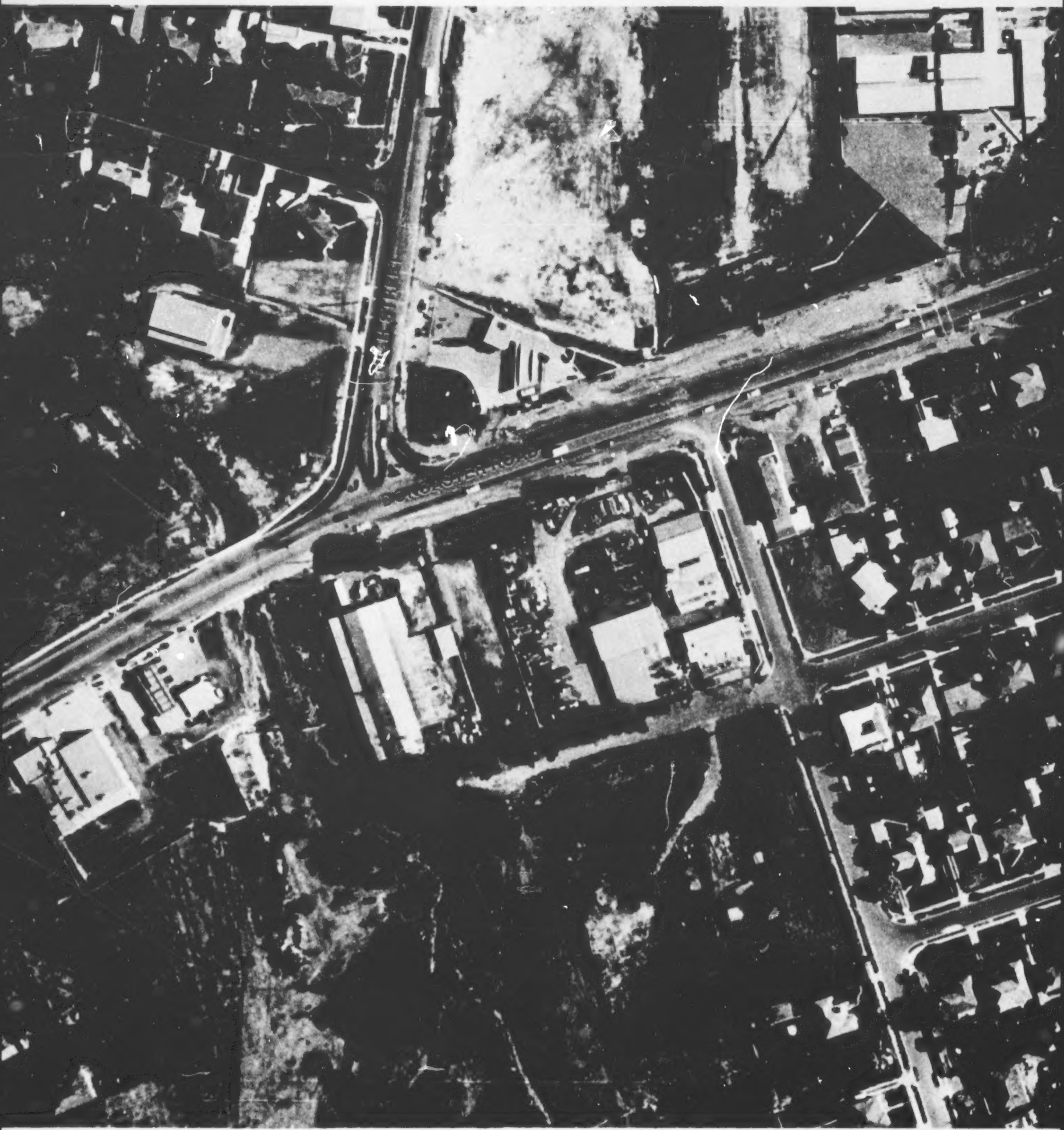

DONCASTER ROAD

Figure 11.3: Vertical aerial photograph of the intersection of High Street and Doncaster Road

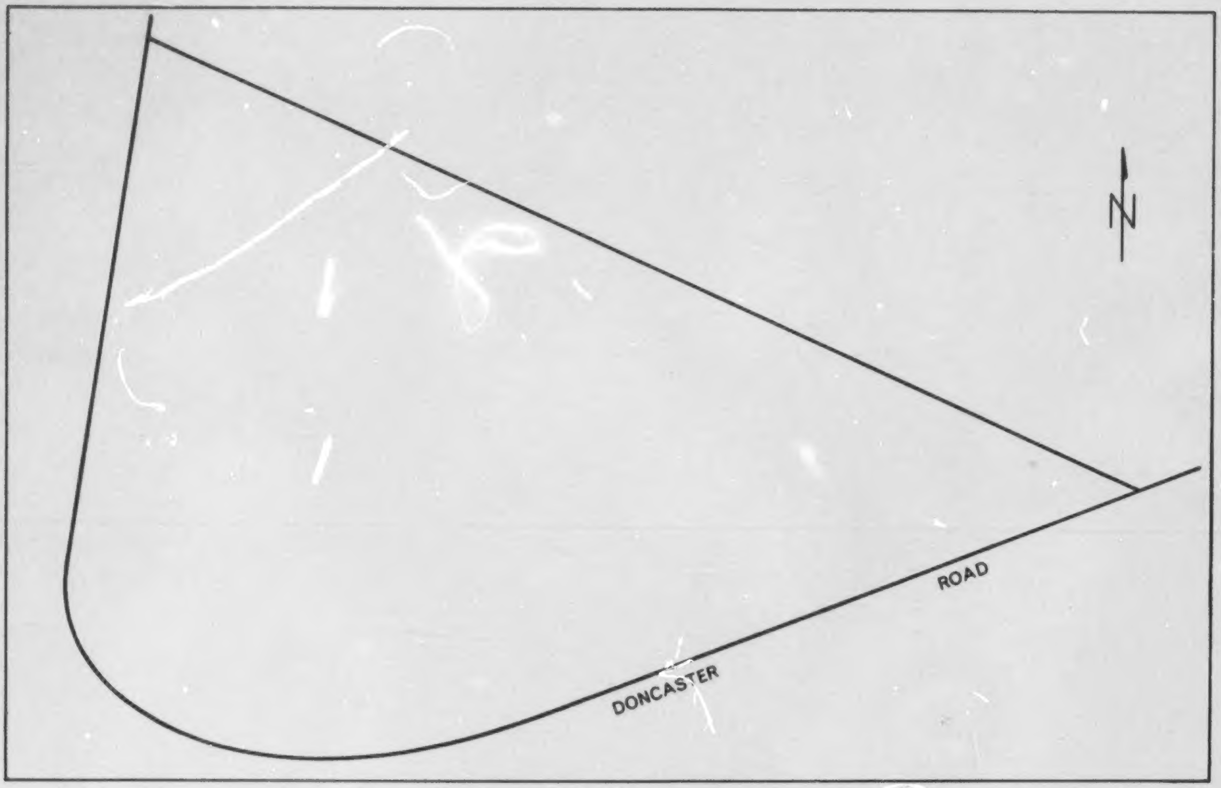

N
ROAD
DONCASTER

Figure 11.4: Site of the service station

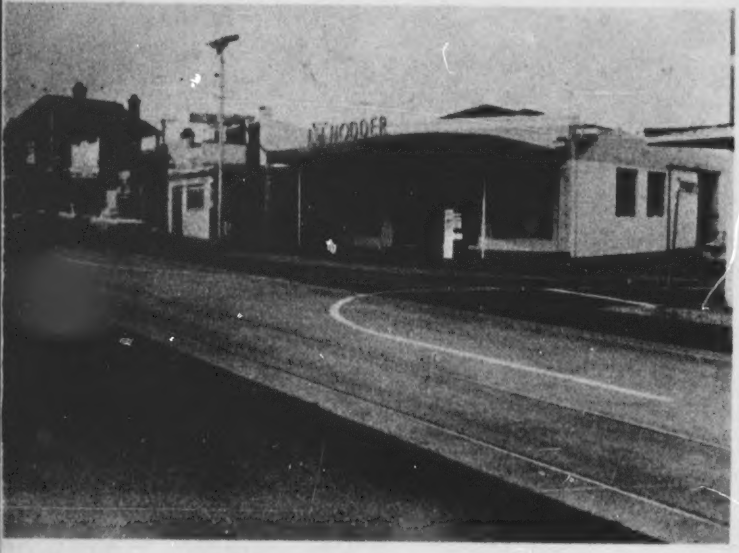


Figure 11.5: Looking towards the garage from across Church Street

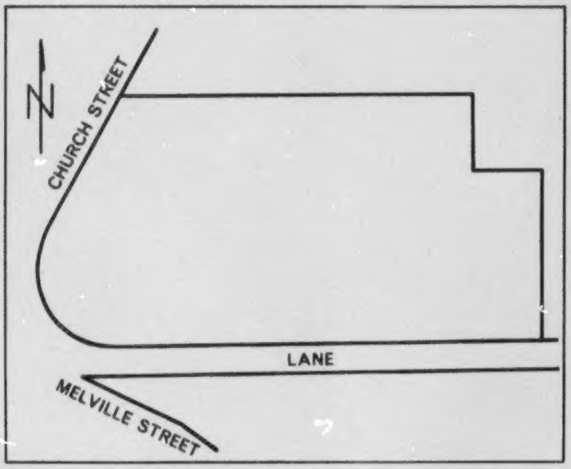

N
CHURCH STREET
LANE
MELVILLE STREET

Figure 11.6: Site of the garage

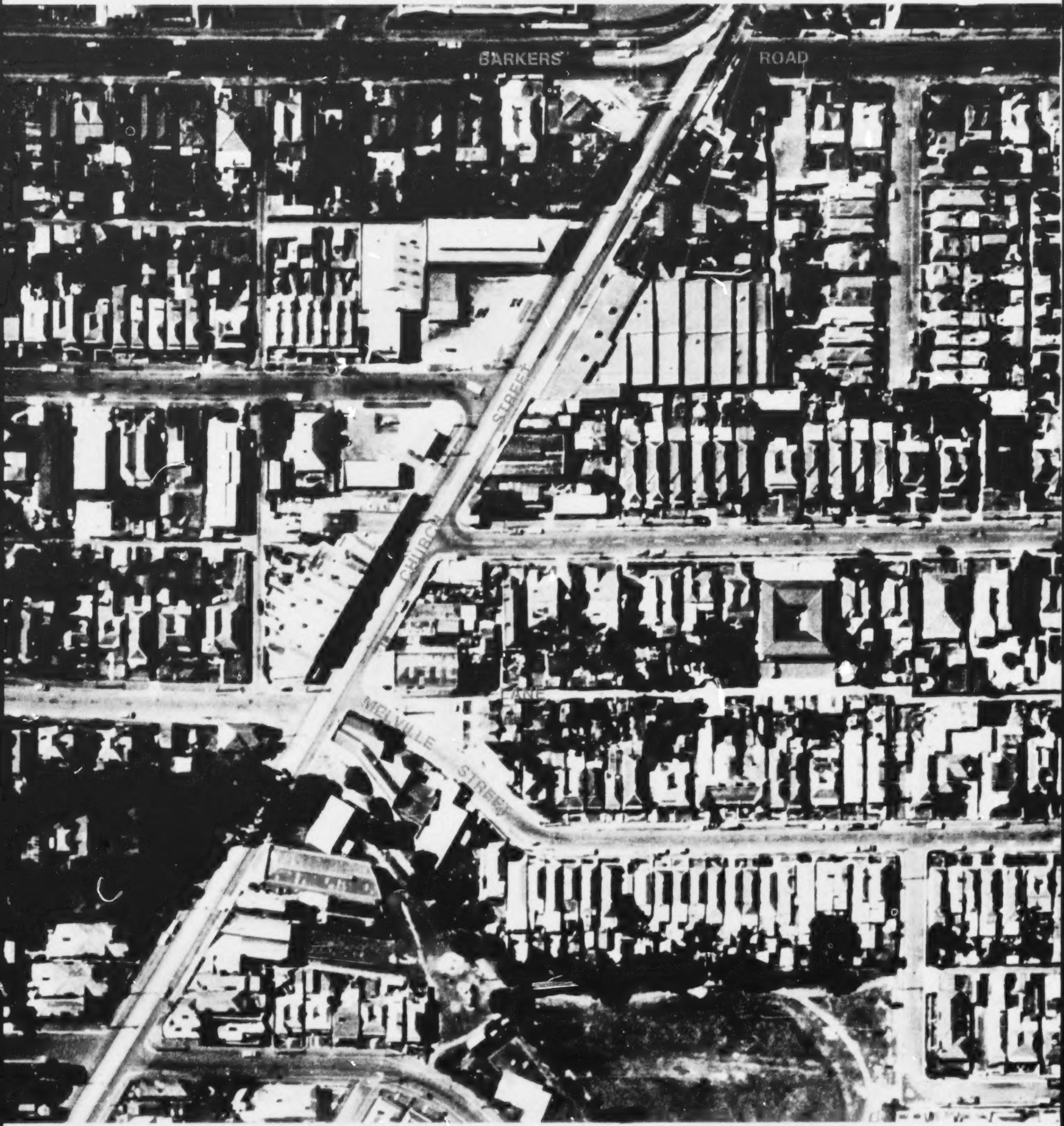

BARKERS' ROAD
CHURCH STREET
LANE
MELVILLE STREET

Figure 11.7: Vertical aerial photograph of Church Street

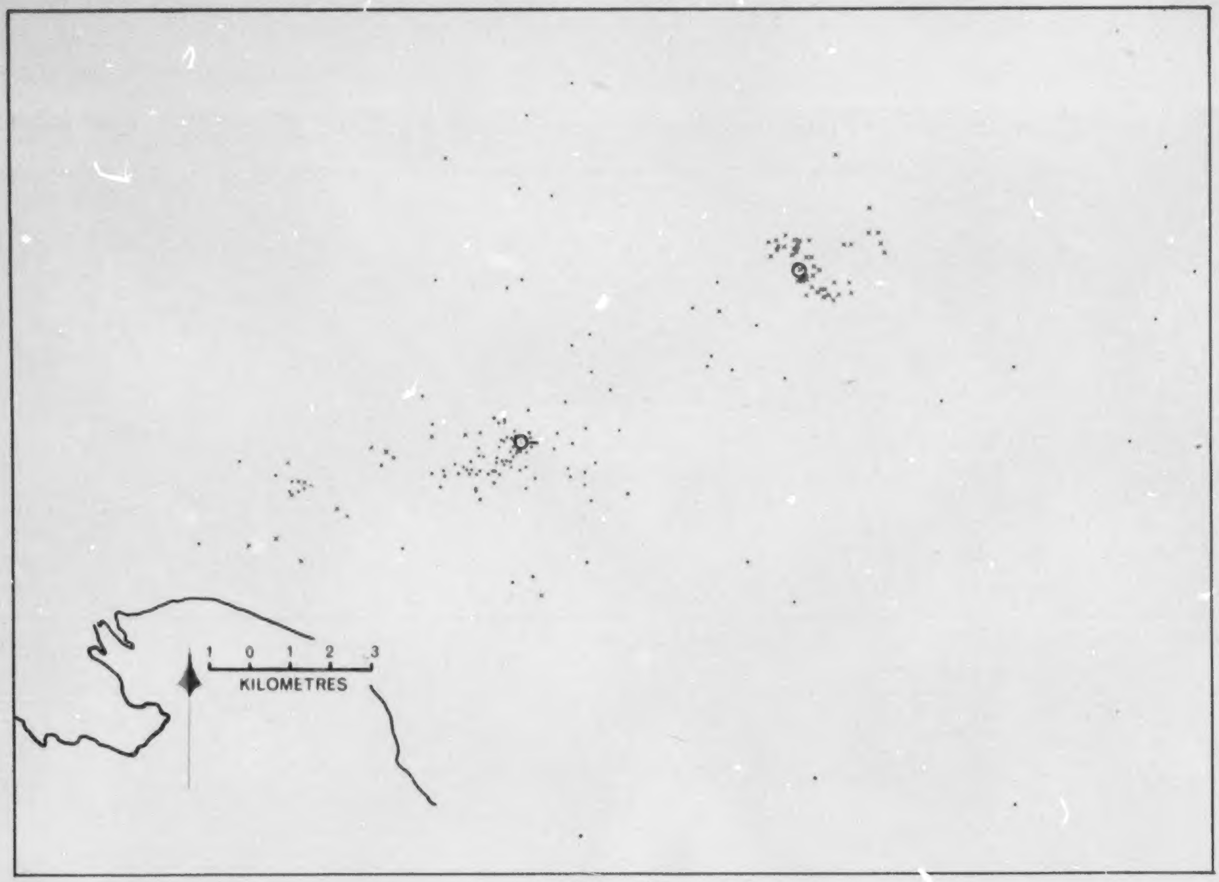
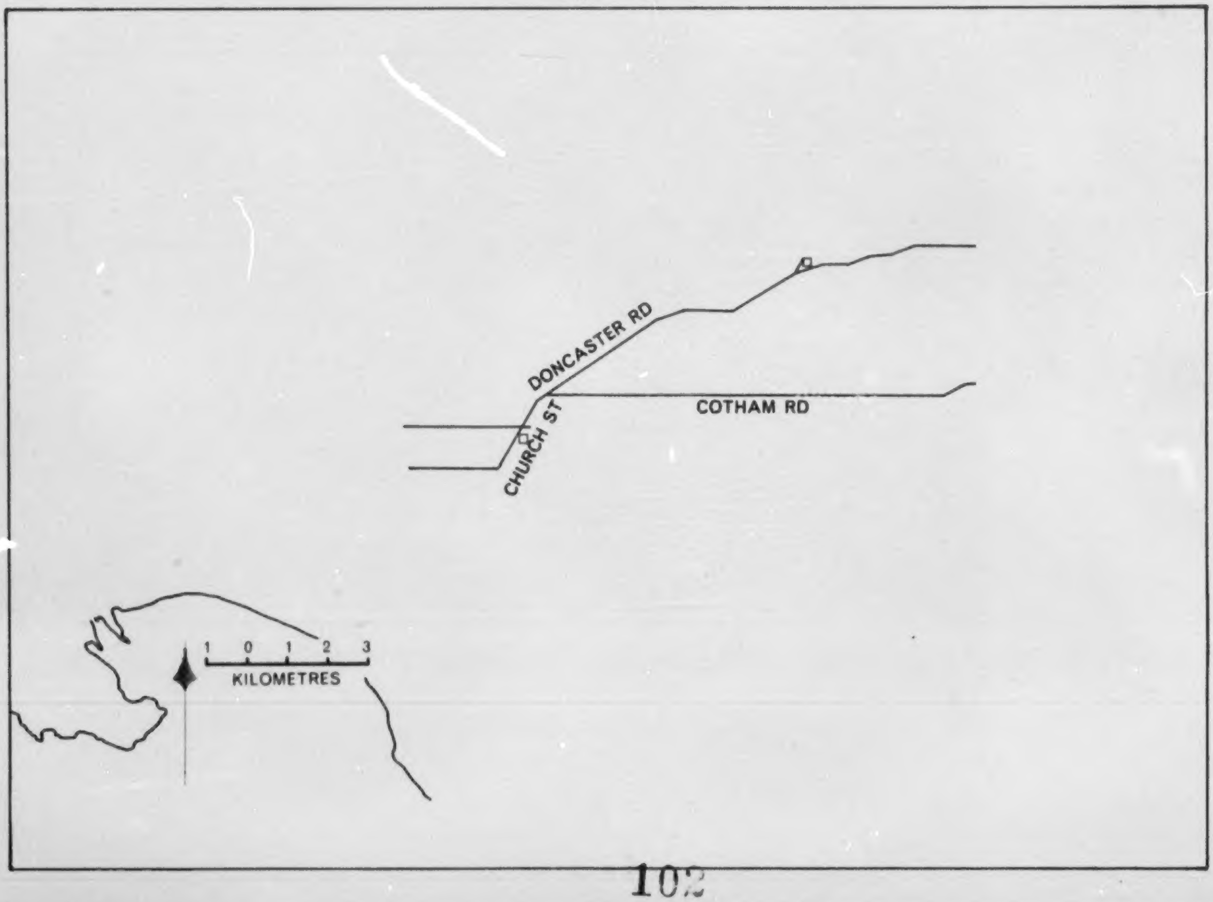

1 0 1 2 3
KILOMETRES

Figure 11.8

Figure 11.9


DONCASTER RD
COTHAM RD
CHURCH ST
1 0 1 2 3
KILOMETRES

customers; he has no idea how many casual customers he has. On the other hand, the garage proprietor knows the addresses of almost all of his customers. What sorts of customers would use a service station and not leave their addresses?

This reveals one major difference between the purpose of the service station and the purpose of the garage. Look firstly at figures 11·5 and 11·10. What is the difference in the appearance of the two? Which is trying to attract attention, and how is it done?

Figure 11·11 shows the number of cars passing along the roads between the garage and the service station on a normal day. Which of the two is in a better place to attract casual customers?

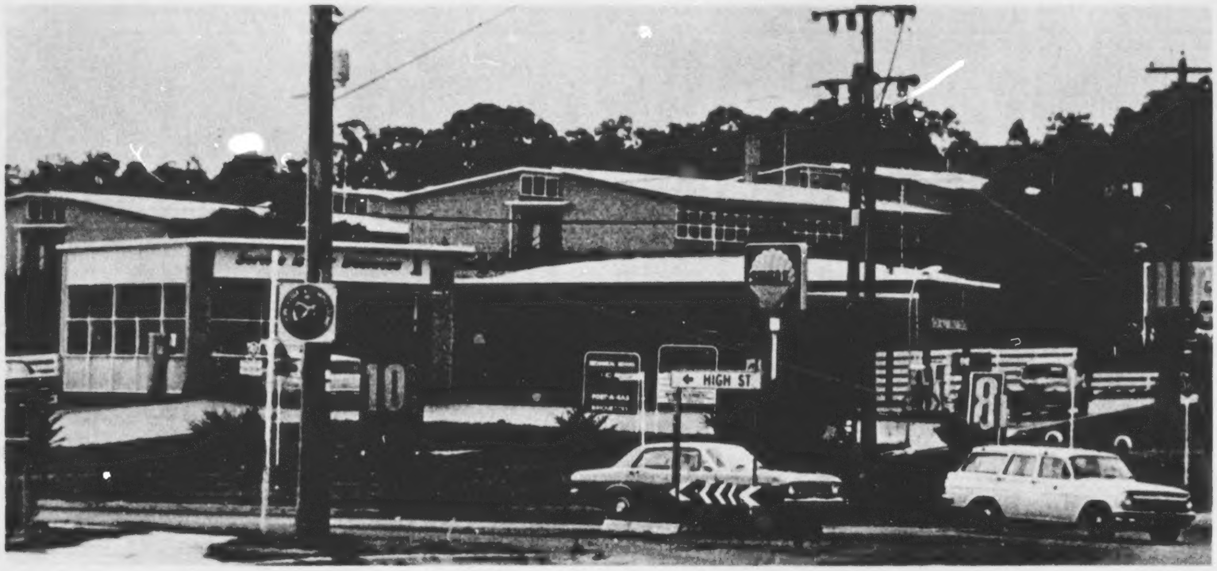
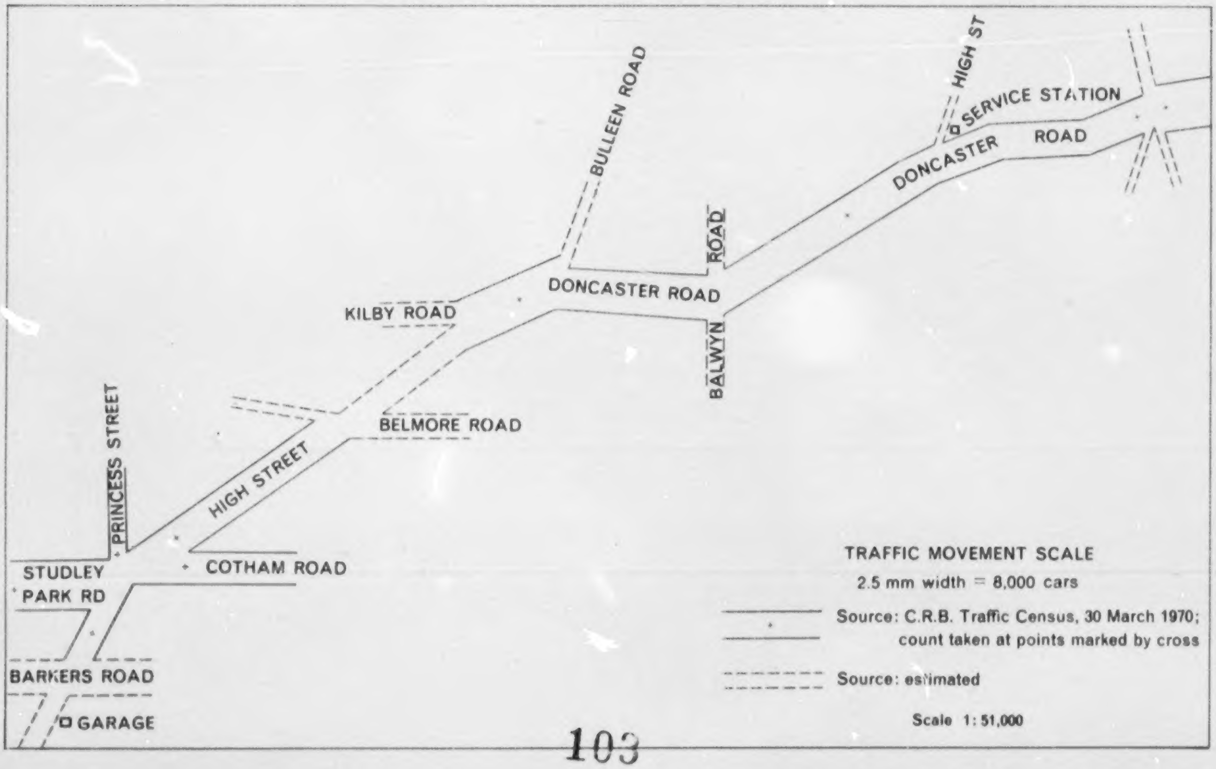


Figure 11.10: The service station

Figure 11.11: Traffic movement along Church Street, High Street, Doncaster Road, with cross roads, etc.


HIGH ST
SERVICE STATION
BULLEEN ROAD
DONCASTER ROAD
ROAD
DONCASTER ROAD
KILBY ROAD
BALWYN ROAD
BELMORE ROAD
PRINCESS STREET
HIGH STREET
STUDLEY PARK RD
COTHAM ROAD
BARKERS ROAD
GARAGE
TRAFFIC MOVEMENT SCALE
2.5 mm width = 8,000 cars
Source: C.R.B. Traffic Census, 30 March 1970; count taken at points marked by cross
Source: estimated
Scale 1: 51,000

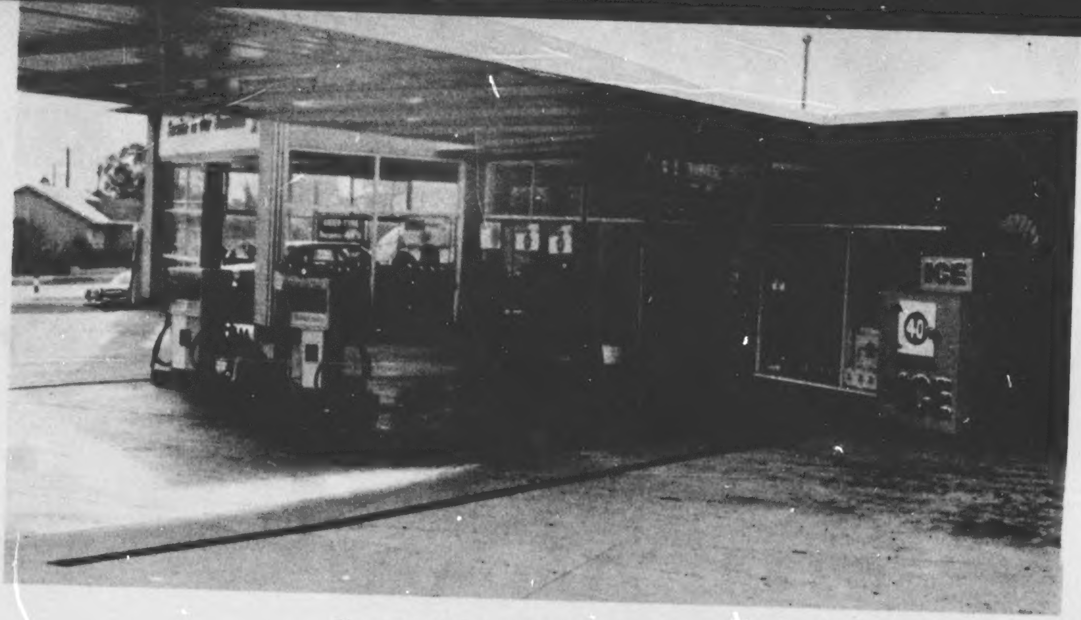
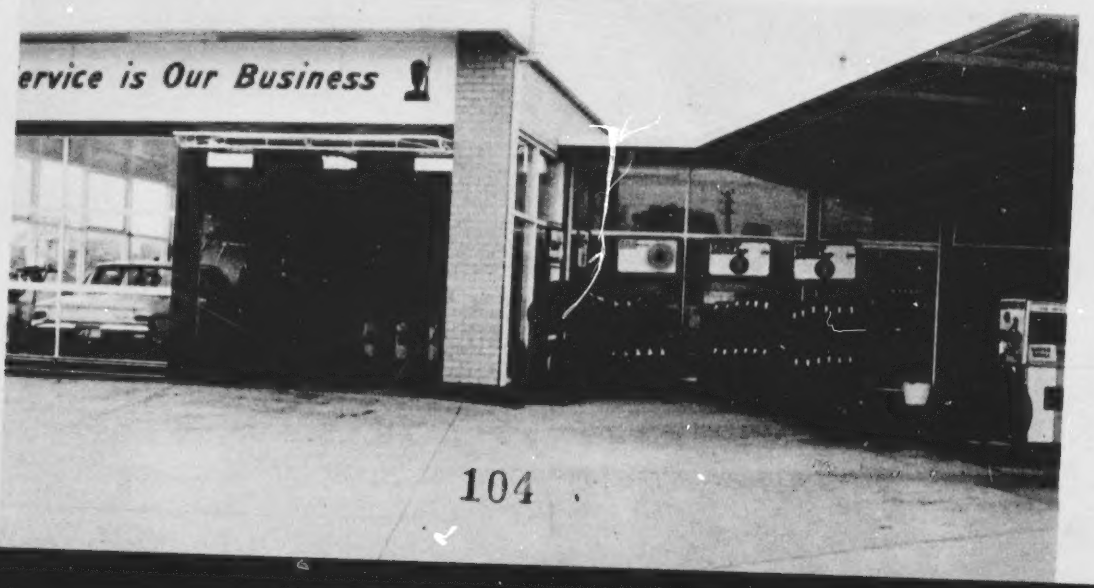
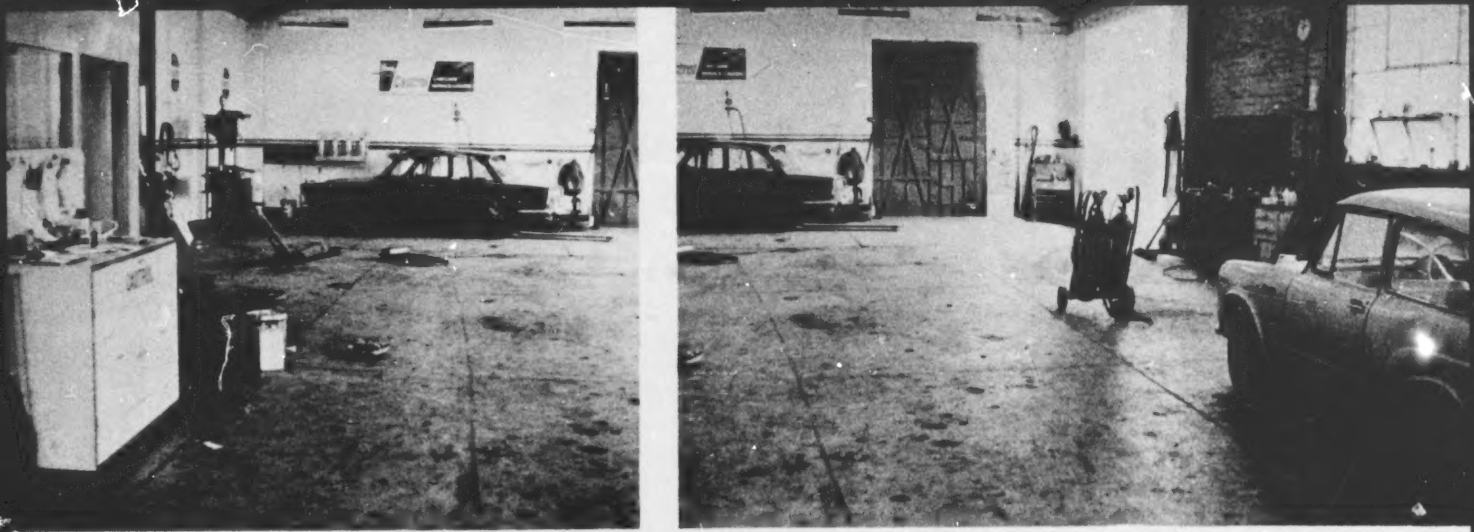


Figure 11.12: The front of the service station

Figure 11.13: The front of the garage

Figure 11.14: The front of the service station


ervice is Our Business



Figures 11.15 and 11.16: Inside the garage

What all this means is that the purpose of the garage is quite different from that of the service station. Look at figures 11·12 and 11·13, photographs of the front of the service station and of the garage. Which attempts to cater most satisfactorily for the casual customer? How?

At the beginning of this topic, you were asked to list what things you thought would happen at the service station. Examine figure 11·14. Should you add anything to your list? In terms of the number of customers who use the service station, which thing on your list do you think is most important? Why?

You will notice that one part of the service station is an area where cars receive special attention under cover. Compare this area in figure 11·14 with the inside of the garage, shown in figures 11·15 and 11·16. When you look at how much of the garage site is covered by the building, and the differences between the inside of the garage and the inside of the service station, what do you think is the most important purpose of the garage? Can you think of a name for it that describes its purpose better than 'garage'?

FURTHER ACTIVITIES

You may like to investigate a service station close to you. Is its building like the garage or the modern service station? Are its purposes the same as the service station or the garage? Can the proprietor tell you where his customers come from? Go and ask him.

You may like to carry out your own traffic survey. This can reveal a lot to you about the type of movement in your own area. Try to record at two different times of the day, morning and afternoon. What differences can be seen? The following layout is a useful one for a traffic survey. You should record for a fifteen minute period and then multiply your records by four to convert them into the numbers of vehicles per hour.

TRAFFIC COUNT

Mark vehicles with a stroke /

DATE:
START TIME:
FINISH TIME:

LOCATION: (road) SIDE: (i.e. N, S, E or W) **TOTALS**

COMMERCIAL: TRUCK OR UTILITY:

SEMI-TRAILER:

BULK TANKER:

PRIVATE: CAR or TAXI:

BICYCLE (PUSH or MOTOR):

PUBLIC: TRAM:

BUS:

ACTIVITIES ON MOVEMENT

Record your answers to the following, working in groups, in pairs or singly.

From where did you come to school? Mark this on a map, showing the locations for the whole class with ray lines showing direct distances.

How long did it take you to get to school?

How did you travel (*mode of transport*)?

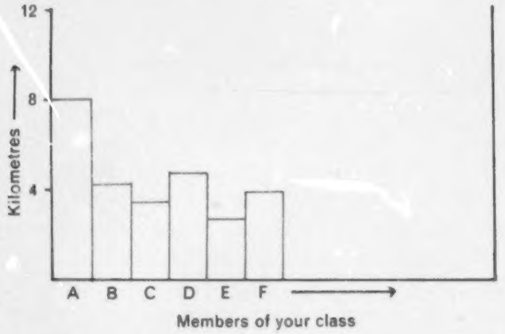
Are time of travel and mode of travel related in the case of your class? In what ways?

Are time of travel and home location related for your class? In what ways?

Are home location and mode of travel related for your class? In what ways?

Your surveys may be recorded as graphs, statistics and maps.

Example 1



Example 2

Class member	Distance	Time
A	10	19
B	9	21
C	6	11

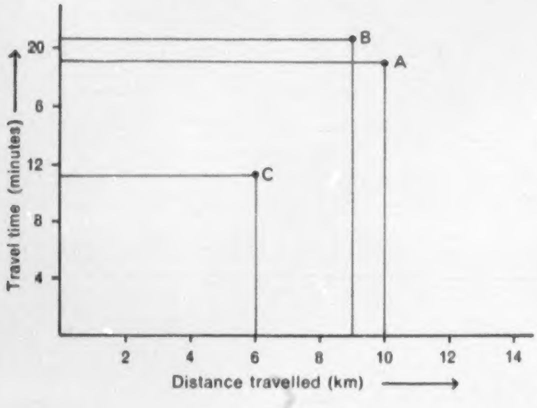
Example 3

Data may be compared most easily by the use of scattergrams. Try [illegible]

Student A has come 10 [illegible] minutes

Student B has come 9 km in 21 minutes

Student C has come 6 km in 11 minutes



When you draw a scattergram for a whole class, it is not necessary to mark in all the letters or the position lines. A dot per student is adequate.

Does a regular pattern emerge? What does this pattern tell you about the transport system around your school? How can you explain any exceptions to your overall pattern?

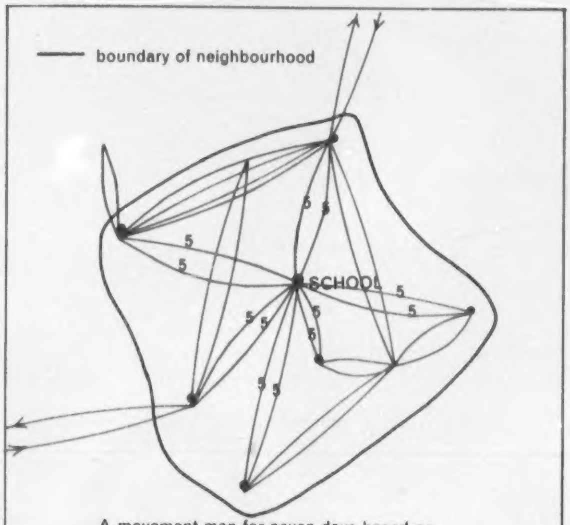
WHAT IS A NEIGHBOURHOOD?

How would you define a neighbourhood? Who would you name as members of your neighbourhood? Is a neighbourhood a collection of buildings? Is it a street?

There are problems in defining a neighbourhood as people who live adjacent to each other. In a city, a person may live beside another person and he lives beside another person . . . so that the whole city would be called a neighbourhood. Yet we would not call a whole city a neighbourhood. Furthermore, people in dwellings beside each other often do not converse or have common interests. Some people who live adjacent to each other never even see each other. People are more likely to regard themselves as neighbours if they have common interests. A neighbourhood could be called a group of persons who have some common interests and who live reasonably close to each other.

To define a neighbourhood, you may follow this sequence:

- Obtain copies of a map of the town, or the section of your city, which you think will include the neighbourhood.
- Record on the map all of your movements for, say, one week. Movements to and from areas



A movement map for seven days based on data supplied by six students outside the map area are noted in the margin of the map.

- Pool the information with that collected by other students and record it on a large master map.
- Decide the number of movements for an area to be classed as a neighbourhood. For example, a neighbourhood may be defined as an area which has more than ten movements. A line may be drawn around this area and it may be called a neighbourhood. See the accompanying diagram.

You may wish to collect data on further questions like:

- Why do people travel?
- For what goods, services, or other reasons do they travel long distances?
- For what things do they travel the least distances?

You may also like to debate such questions as:

- Should cities be planned?
- What are the features of an ideal city? (See pages 146-7 on 'My Ideal Town'.)

12

The neighbourhood system: Elizabeth, an example of planning

Most of us are sometimes asked to go shopping for our parents. Make a list of the things that you have been asked to buy. Now, with the list in front of you, count how many of these things are food. It may be that there are other things, too — medicine from the chemist, a magazine from the newsagent, a reel of cotton from the draper, stamps from the post office, or dry cleaning to be collected from the agent. But it will probably be true that your list is mainly concerned with food, and that you know your way well to the grocer, the butcher, the fruit and vegetable shop and the delicatessen. The things that we need often from the shops are sometimes called 'convenience goods'; for our convenience the shops which sell them need to be close to our homes.

Now make a sketch map of the route you follow when you go shopping. Are all the shops close together in one street and on one side of it? Do you have to cross a road carrying heavy traffic to reach some of them, or are they all grouped in a new shopping centre? Are they close to your school, so that you can do your errands without trouble on your way home, or is your school in another part of the district altogether? How far would you have to walk from the first shop to the last, if your errands took you to all of them? Before reading further, make a plan for yourself showing an ideal arrangement of shops which you would find most convenient to use.

Expert town planners have considered this problem, too, and have produced a wide variety of solutions. When a completely new town is being built, the chance is there to try out some of these plans in practice. Figure 12·1 shows one of the neighbourhood shopping centres in Elizabeth, South Australia. Study it carefully, and make three lists:

- Food shops
- Other shops
- Community services that are not shops.

Now look at your own shopping list with which you started: could you have found all the shops you needed in Elizabeth South? Use the scale on the plan to work out how far you would have to walk from the first shop to the last if you did your shopping there. Is this more or less than the distance you calculated for your own shopping area?

Notice that the shops face areas of footpaths, trees, gardens and lawns, and those which might have heavy goods to unload have unloading bays at their back doors. Shoppers who come by car can use large areas of parking space not far away. How far would one have to walk, from the nearest car park in each case, to the delicatessen, the butcher, the greengrocer, the doctor's consulting room? How far is it from each of these places to the bus stop?

Figure 12·2 shows the whole neighbourhood of Elizabeth South which is served by this shopping centre. Use the scale on figure 12·1 to find out how far it is by the shortest road route from the most distant house in the neighbourhood to the centre of the shopping area. Is this a reasonable distance for a boy or girl to walk? How long would you take to walk the distance? How long if you rode a bicycle? Roughly north of the main shopping centre (figure 12·2, ref. K19), there is another group of shops. Why are they there? What kind of shops would you expect them to be? Is there any advantage for a mother with a small child in having the infant school close to the shopping centre? Note on the other hand that the high school, which has to serve several neigbourhoods, is on the edge of the area.

4,300 people live in Elizabeth South. They need not travel far to work for nearby there is a planned industrial area, shown in figure 12·3, which contains a variety of factories, but no houses. Many older manufacturing towns have houses and factories close to each other in the same area. Are there any advantages in such an arrangement for the factory worker? What are the disadvantages? The General Motors-Holden's area in figure 12·3 shows a system of railway lines leading to the factory buildings: what is the purpose of these? The line at the top of the plan is the main northern railway

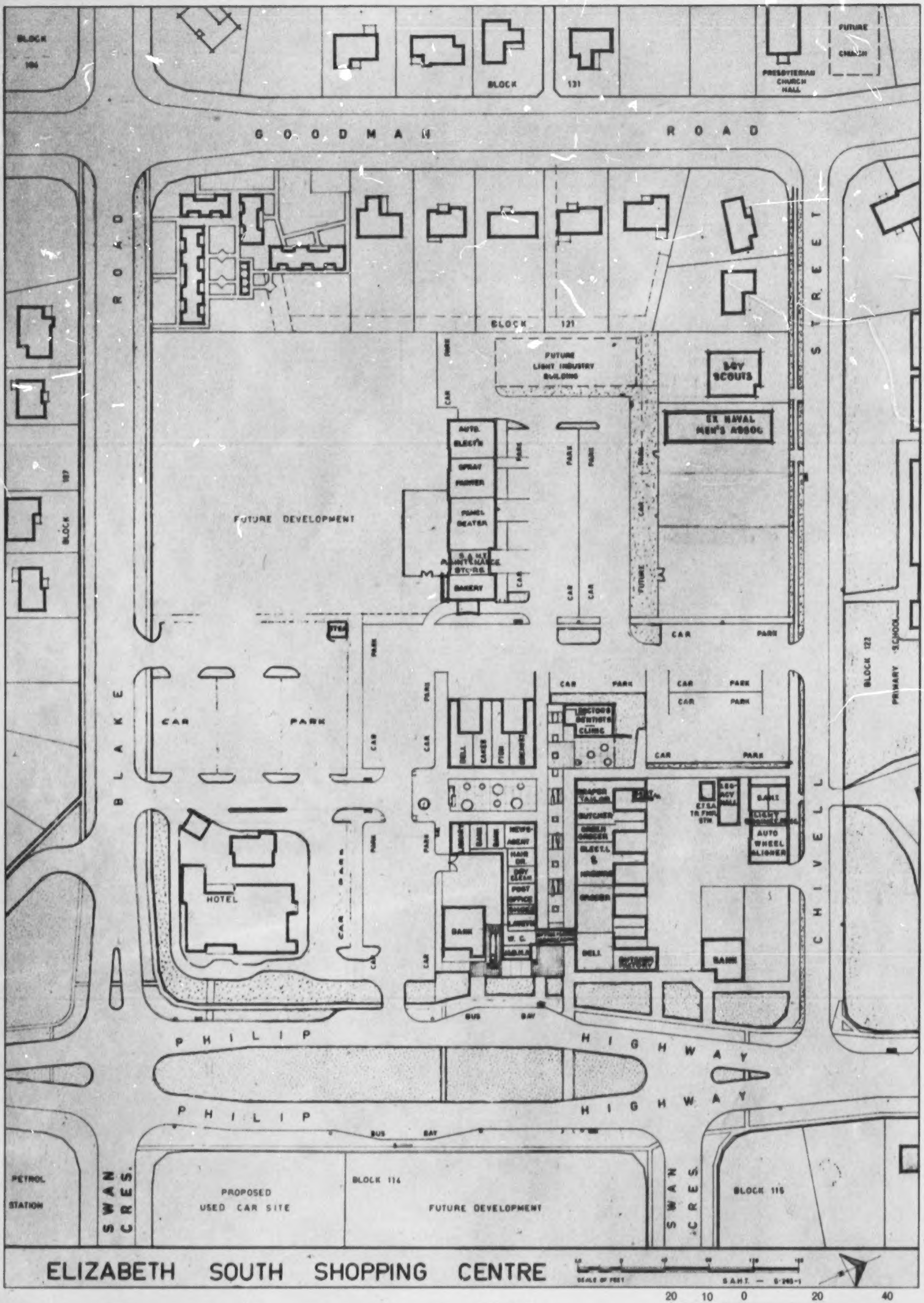
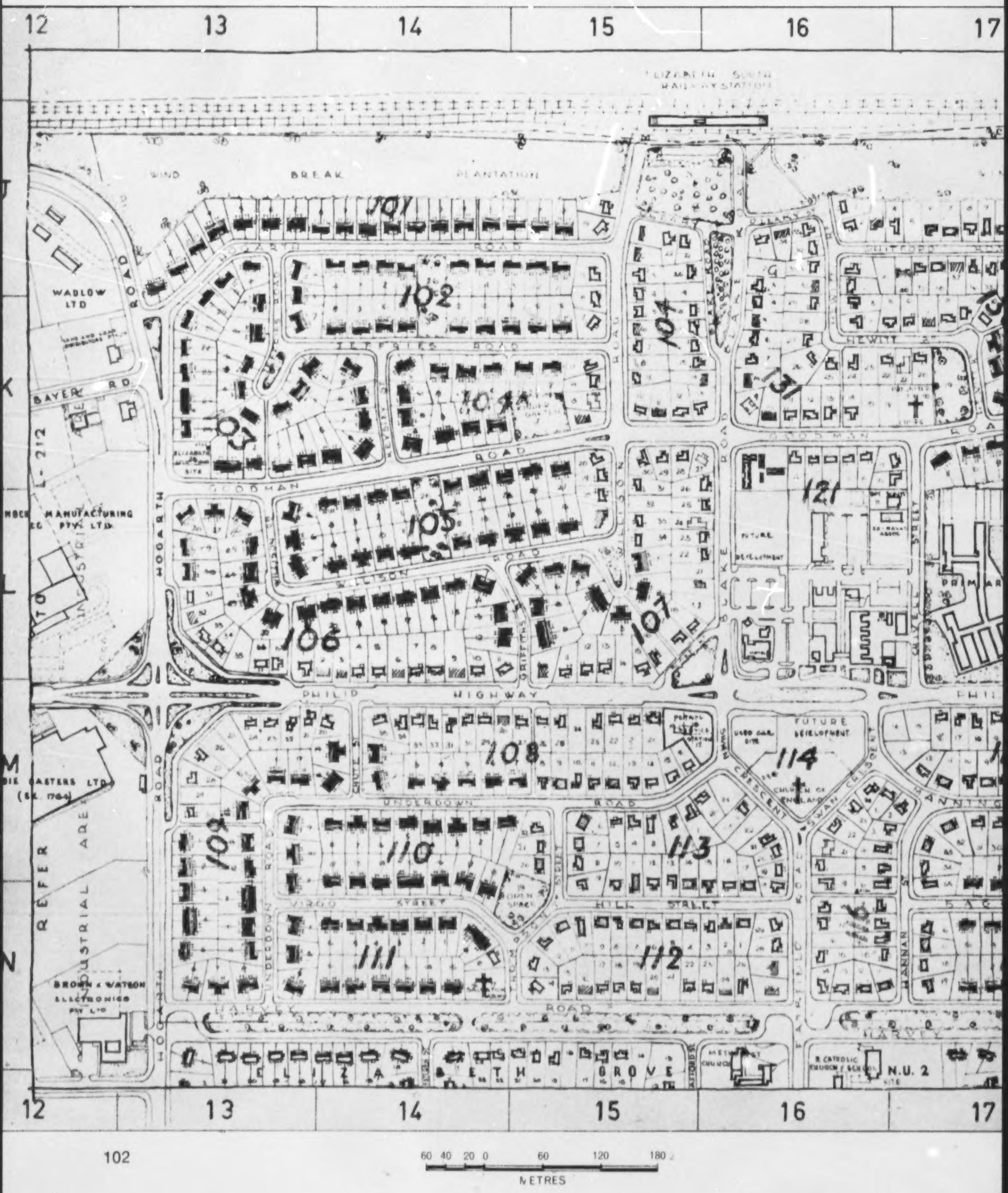

ELIZABETH SOUTH SHOPPING CENTRE
GOODMAN ROAD
BLAKE ROAD
CHIVELL STREET
PHILIP HIGHWAY
PHILIP HIGHWAY
SWAN CRES.
SWAN CRES.
BLOCK 104
BLOCK 131
BLOCK 121
BLOCK 107
BLOCK 122
BLOCK 114
BLOCK 115
PRESBYTERIAN CHURCH HALL
FUTURE CHURCH
FUTURE LIGHT INDUSTRY BUILDING
BOY SCOUTS
EX NAVAL MEN'S ASSOC
PRIMARY SCHOOL
FUTURE DEVELOPMENT
AUTO ELECT'N
SPRAY PAINTER
PANEL BEATER
S.A.H.T. MAINTENANCE STORE
BAKERY
CAR PARK
HOTEL
DELI
CAKES
FISH
DOCTORS DENTISTS CLINIC
NEWS-AGENT
HAIR DR.
DRY CLEAN
POST OFFICE
W. C.
BANK
DRAPER TAILOR
BUTCHER
GREEN GROCER
ELECT'L &
GROCER
DELI
E.T.S.A. TR. FMR. STN
AUTO WHEEL ALIGNER
BANK
BANK
BUS BAY
BUS BAY
PETROL STATION
PROPOSED USED CAR SITE
FUTURE DEVELOPMENT
SCALE OF FEET
S.A.H.T. — S·265·1
20 10 0 20 40
METRES

Figure 12.


12
13
14
15
16
17
ELIZABETH SOUTH RAILWAY STATION
WIND BREAK PLANTATION
101
102
103
104
105
106
107
108
109
110
111
112
113
114
121
131
HOGARTH ROAD
JEFFRIES ROAD
GOODMAN ROAD
WILLISON ROAD
GRIFFITHS
BLAKE ROAD
HEWITT
PHILIP HIGHWAY
UNDERDOWN ROAD
VIRGO STREET
HILL STREET
SWAN CRESCENT
CRESCENT
MANNING
HARVEY ROAD
ELIZABETH GROVE
WADLOW LTD
BAYER RD
L-212
MANUFACTURING CO PTY LTD
DIE CASTERS LTD (SE 1764)
INDUSTRIAL AREA
REFFER
BROWN & WATSON ELECTRONICS PTY LTD
FUTURE DEVELOPMENT
USED CAR SITE
CHURCH OF ENGLAND
PRIMARY
OPEN SPACE
METHODIST CHURCH
R. CATHOLIC CHURCH & SCHOOL
N.U. 2 SITE
102
60 40 20 0 60 120 180
METRES

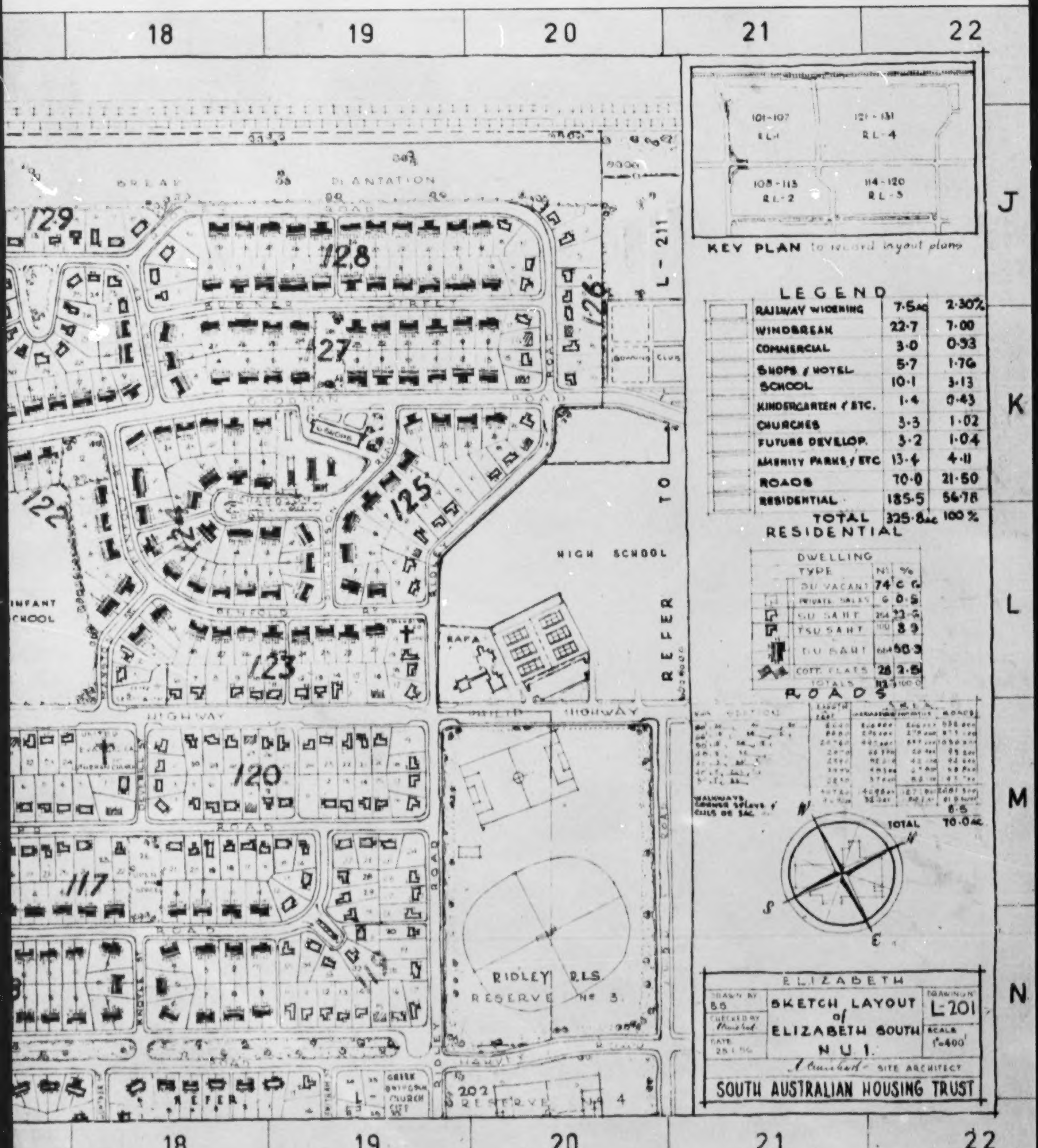
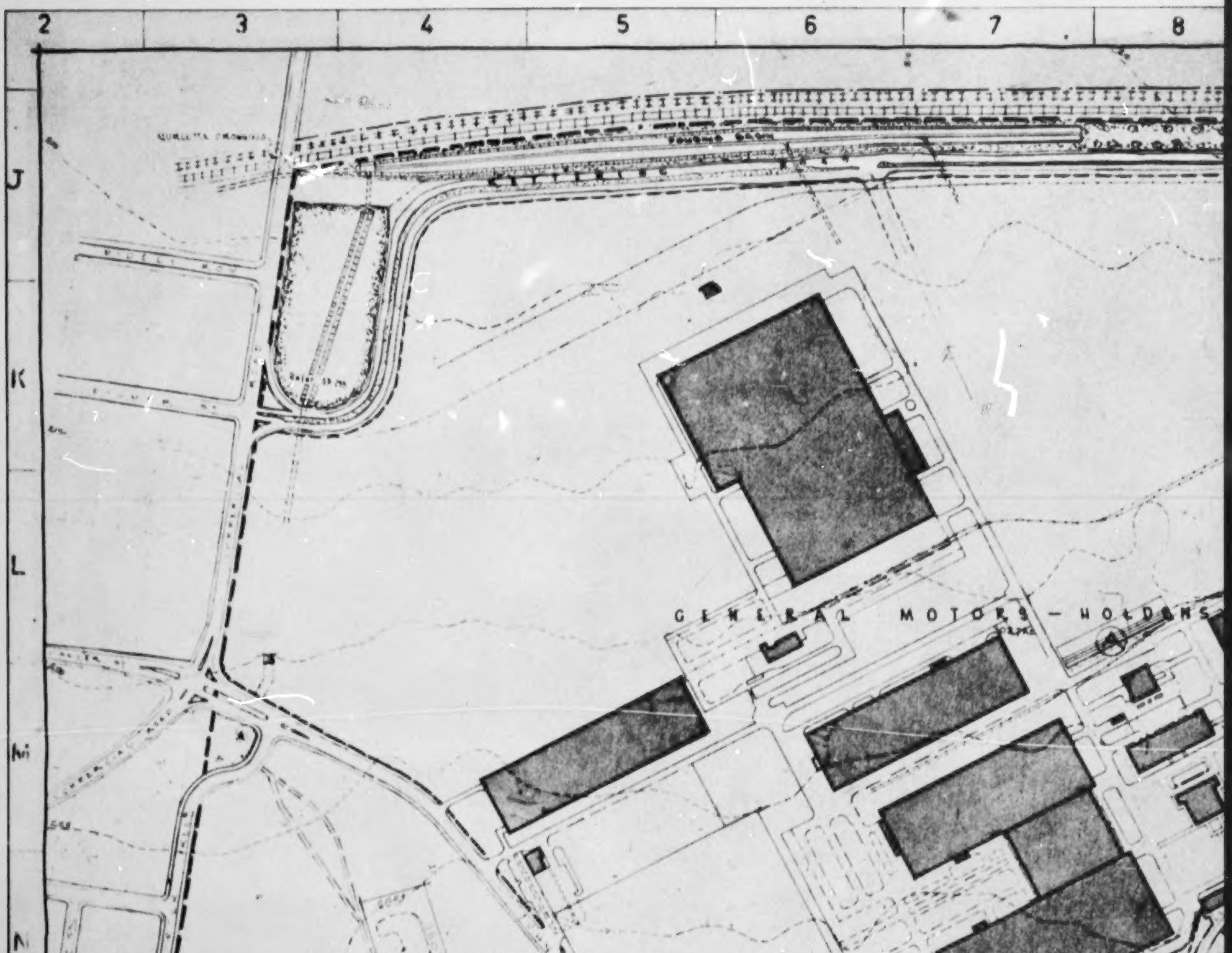

18
19
20
21
22
J
K
L
M
N
BREAK PLANTATION ROAD
129
128
127
126
125
123
122
120
117
L - 211
INFANT SCHOOL
HIGH SCHOOL
RAFA
HIGHWAY
ROAD
REFER TO
RIDLEY RESERVE
R.L.S. No 3.
RESERVE No 4
202
GREEK ORTHODOX CHURCH SITE
KEY PLAN to record layout plans
101-107 RL-1
121-131 RL-4
108-115 RL-2
114-120 RL-5
LEGEND
RAILWAY WIDENING 7·5ac 2·30%
WINDBREAK 22·7 7·00
COMMERCIAL 3·0 0·33
SHOPS / HOTEL 5·7 1·76
SCHOOL 10·1 3·13
KINDERGARTEN / ETC. 1·4 0·43
CHURCHES 3·3 1·02
FUTURE DEVELOP. 3·2 1·04
AMENITY PARKS / ETC 13·4 4·11
ROADS 70·0 21·50
RESIDENTIAL 185·5 56·78
TOTAL 325·8ac 100%
RESIDENTIAL
DWELLING TYPE
ROADS
TOTAL 70·0ac
N
S
E
W
ELIZABETH
SKETCH LAYOUT of ELIZABETH SOUTH N.U.1.
L-201
SITE ARCHITECT
SOUTH AUSTRALIAN HOUSING TRUST

Figure 12.2


2
3
4
5
6
7
8
J
K
L
M
N
O
P
GENERAL MOTORS - HOLDENS
A
AUSTRAL
CRANE
T
U
Z
Y
SCHRADER - SCOVILL CO PTY LTD
VACUUM OIL CO
TRANSWAY SERVICES LTD
PTY LTD
PRIMARY SCHOOL
104
100
50
0
100
200
300
400
METRES

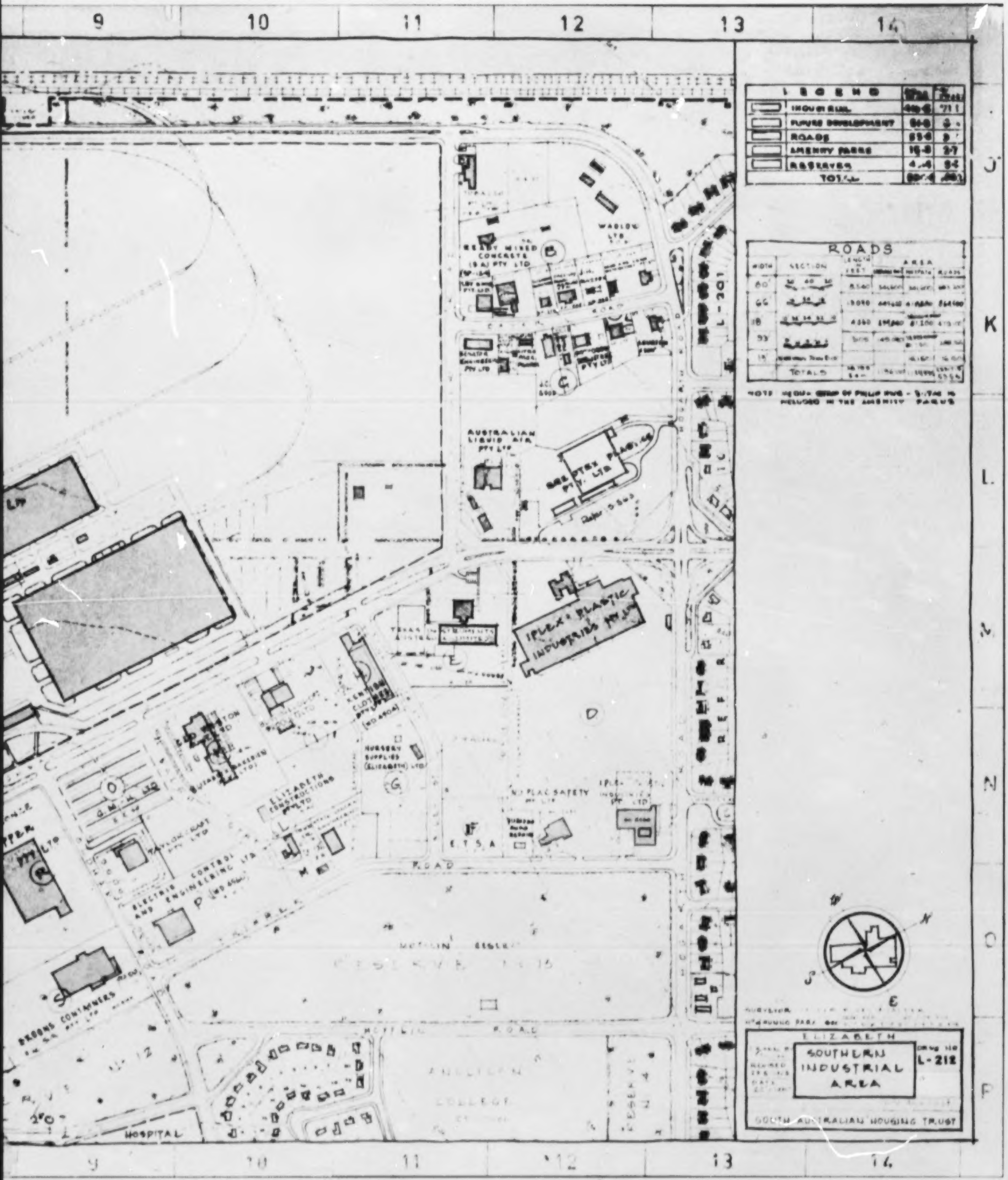

9
10
11
12
13
14
J
K
L
M
N
O
P
LEGEND
INDUSTRIAL
FUTURE DEVELOPMENT
ROADS
AMENITY PARKS
RESERVES
TOTAL
ROADS
WIDTH
SECTION
LENGTH IN FEET
AREA
ROADS
TOTALS
READY MIXED CONCRETE (S.A.) PTY LTD
WADLOW LTD
B
C
AUSTRALIAN LIQUID AIR PTY LTD
IPLEX PLASTIC INDUSTRIES PTY LTD
D
E
F
E.T.S.A.
G
NURSERY SUPPLIES (ELIZABETH) LTD
ELIZABETH CONSTRUCTIONS PTY LTD
G.M.H. LTD
TAYLOR-BART PTY LTD
ELECTRIC CONTROL AND ENGINEERING LTD
P
R
ROAD
RESERVE
HOSPITAL
L-201
L-212
ELIZABETH
SOUTHERN INDUSTRIAL AREA
SOUTH AUSTRALIAN HOUSING TRUST
N
S
E
W

Figure 12.3

of South Australia, linking with Alice Springs and the Indian-Pacific line. Do you think this adds value to this industrial area? Why?

Figure 12·4 shows this area. Relate it to the plan and say in which direction we are looking in the photograph. How are the open spaces shown in the General Motors-Holden's area of the plan actually used? What does this tell us about transport habits in the district? Do you think that the road system has been planned for this purpose? Why? Would all the people who work in this area live in Elizabeth South? Why? Locate in the photograph the Elizabeth South shopping centre, and the definite boundary between the housing and the industrial zones. Harvey Road, the north-eastern boundary of Elizabeth South, runs through the centre background, and to the right of this is another neighbourhood unit called Elizabeth Grove, which also has its shops and primary school near its centre. Where could the people of Elizabeth Grove work?

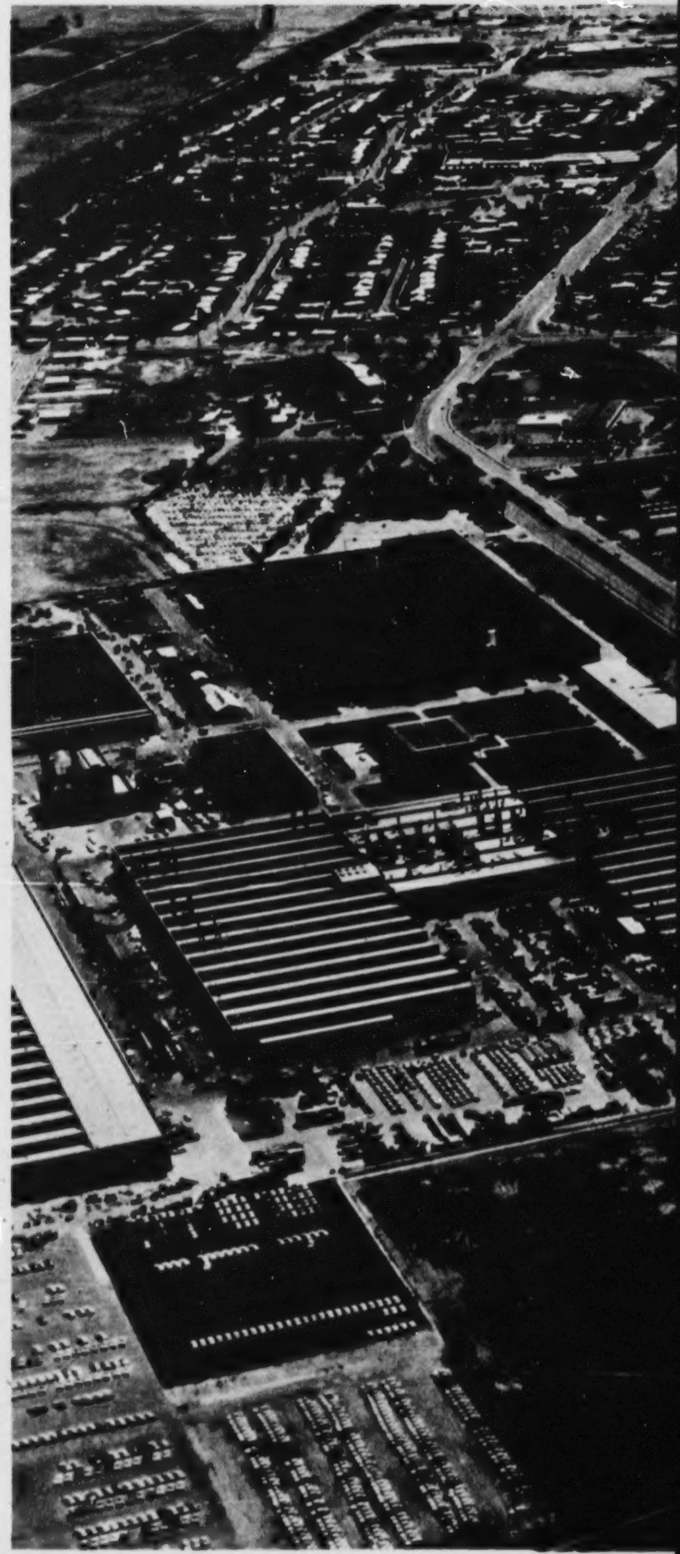
Returning now to your shopping errands — did your mother ever ask you to buy new curtains for the dining room or a new hat for her? Probably not, for these are things people like to choose carefully after comparing the different kinds which are available. They are called 'comparison goods' for that reason. The widest choice is found in the largest shops, but large shops in every neighbourhood could hardly expect to make a living.

In Elizabeth a Town Centre was planned to include such shops, as well as those selling convenience goods for the people living near it. Figure 12·5 is a plan of the Town Centre. Make three lists, using map and legend, as you did before:

- Food shops
- Other shops
- Community services that are not shops.

Compare this list with the one that you made for Elizabeth South, and note any differences between them. Besides having big shops, another way to give customers a wider choice than the neighbourhood shopping centre offers is for shops to be more specialised. For example, Elizabeth South has a draper's shop, but in the Town Centre there are separate shops for ladies' clothing, ladies' shoes, men's wear, lingerie and bridal wear, as well as a general draper with a shop three times the size of the others.

In addition to shops, we notice that a theatre and a library serve the cultural needs of all the surrounding neighbourhoods and that aspects of government are represented in the municipal offices and the law courts. In figure 12·6 we can see other things on the fringe of the Town Centre



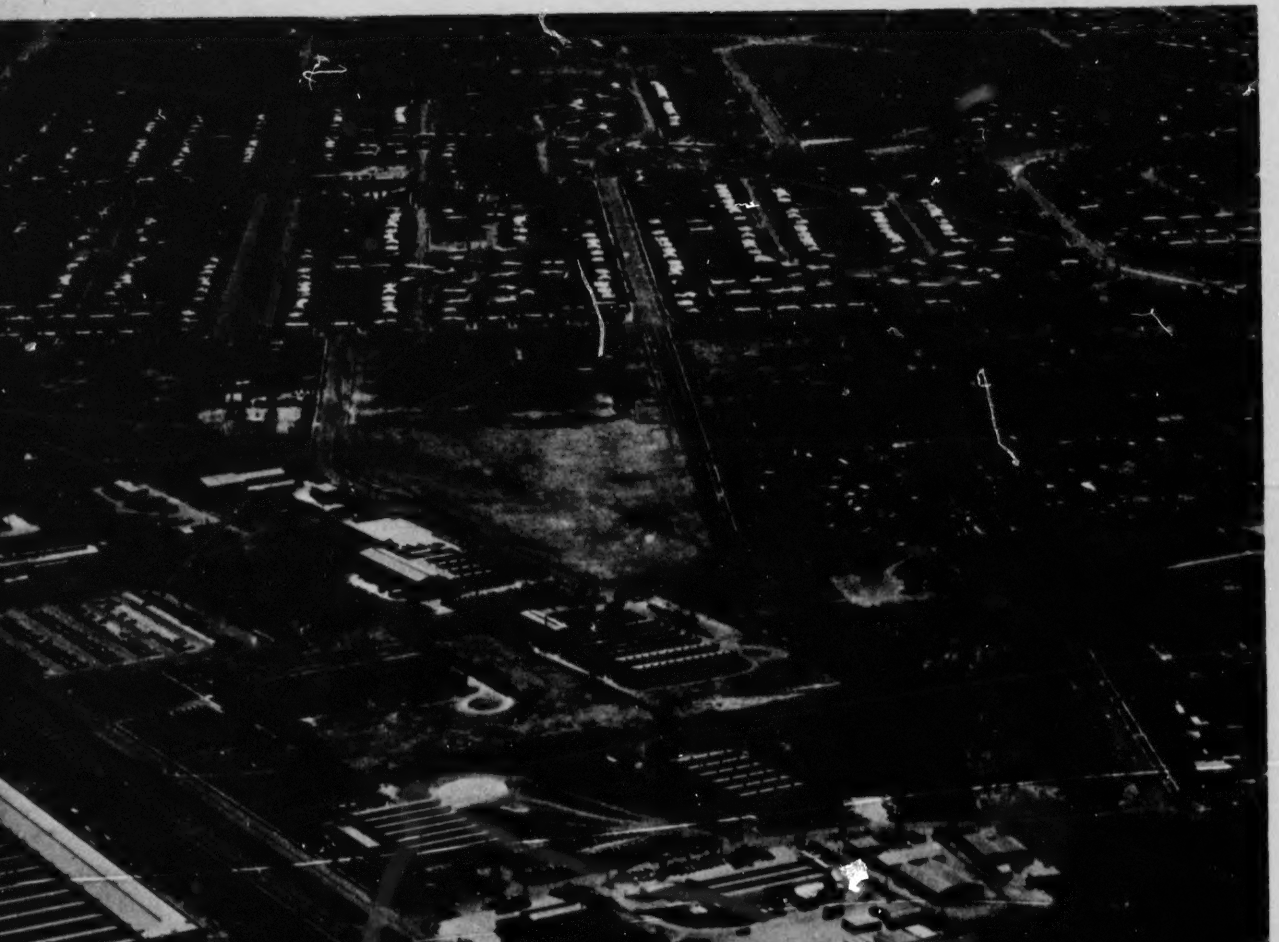
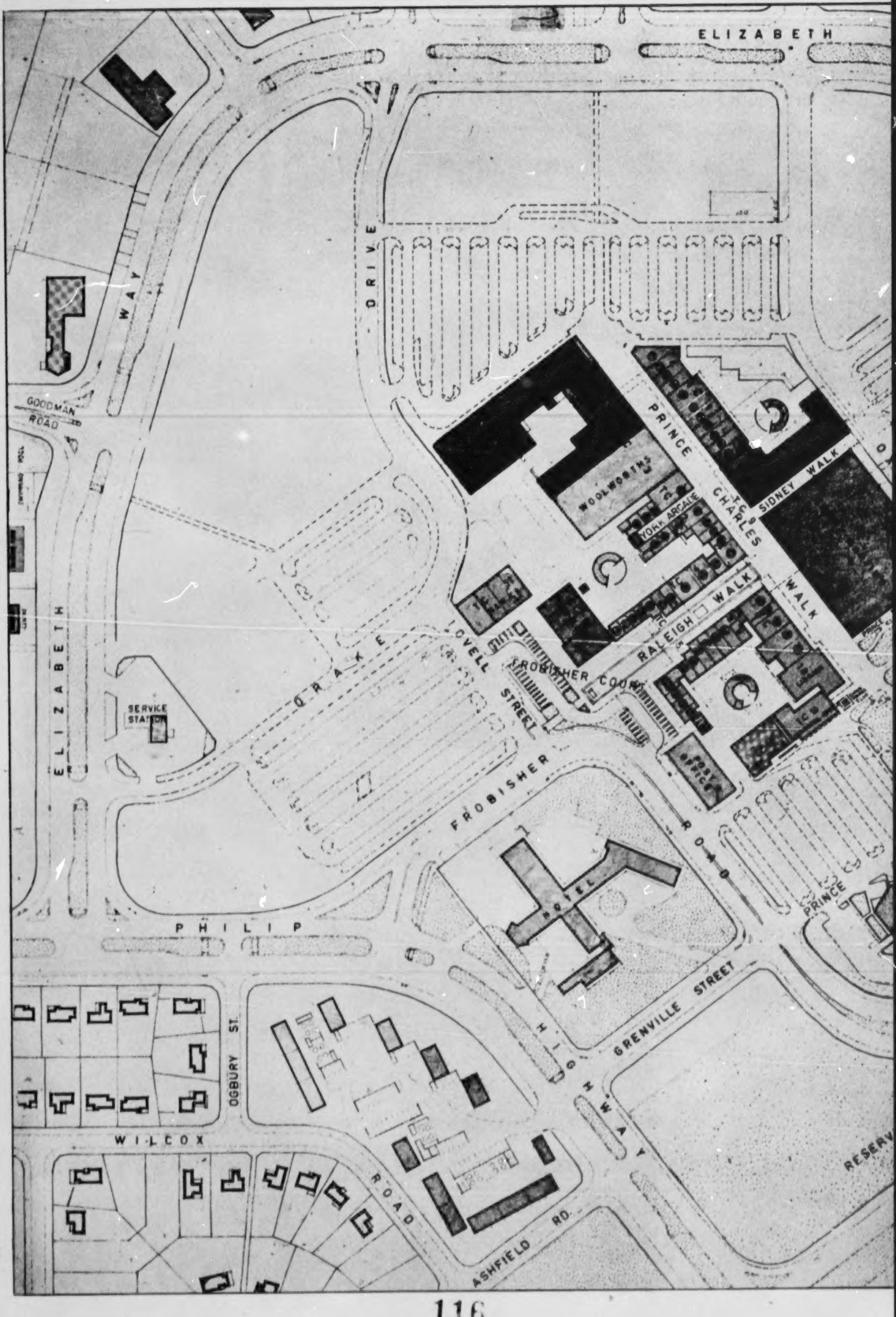


Figure 12.4 (S. A. Housing Trust and Darian Smith)


ELIZABETH
WAY
DRIVE
GOODMAN ROAD
ELIZABETH
SERVICE STATION
DRAKE
LOVELL STREET
FROBISHER COURT
PRINCE CHARLES WALK
WOOLWORTHS
YORK ARCADE
SIDNEY WALK
RALEIGH WALK
T.C.
POST OFFICE
FROBISHER ROAD
HOTEL
PHILIP
PRINCE
GRENVILLE STREET
HIGHWAY
OGBURY ST.
WILCOX
ROAD
ASHFIELD RD.
RESERV

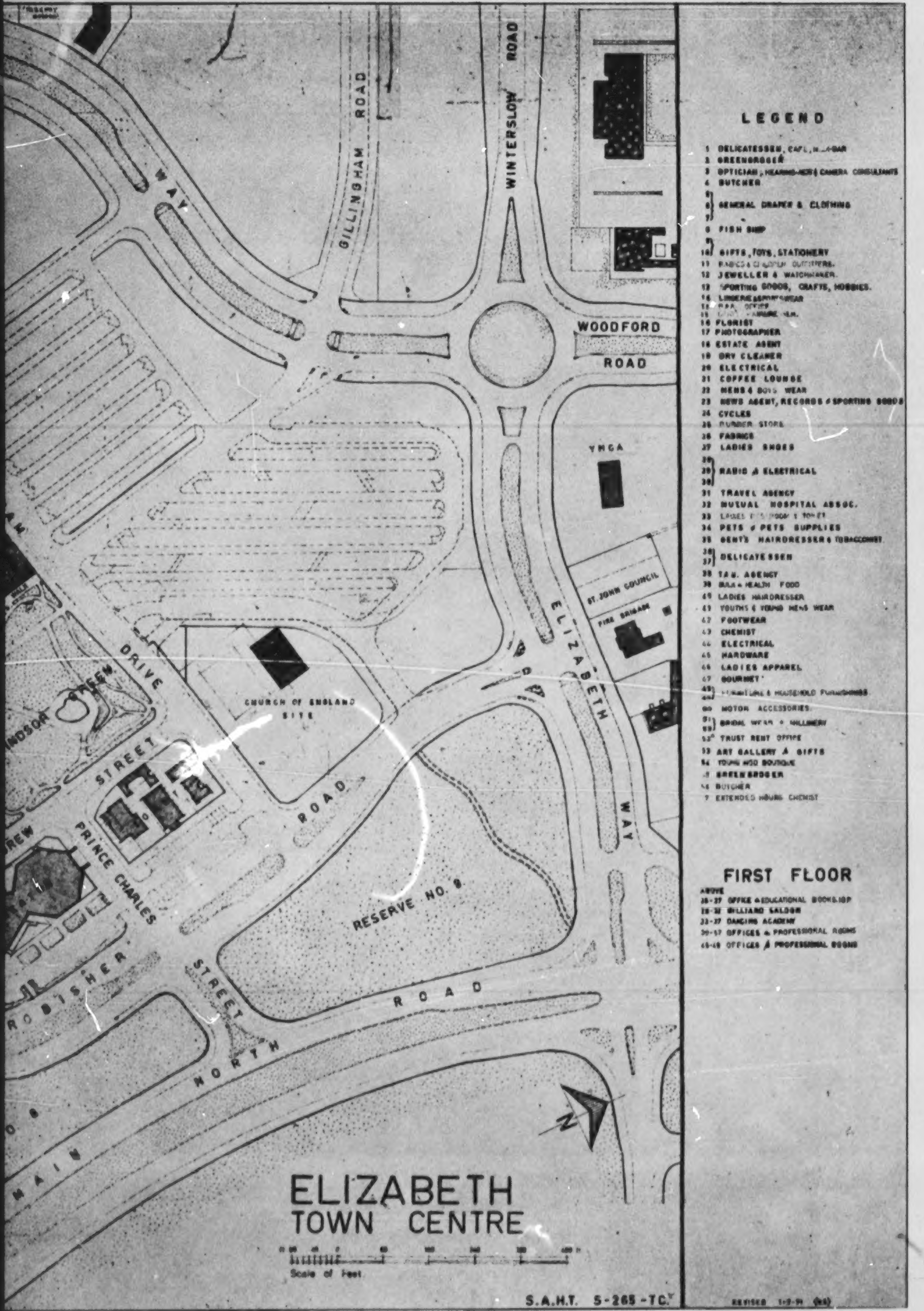
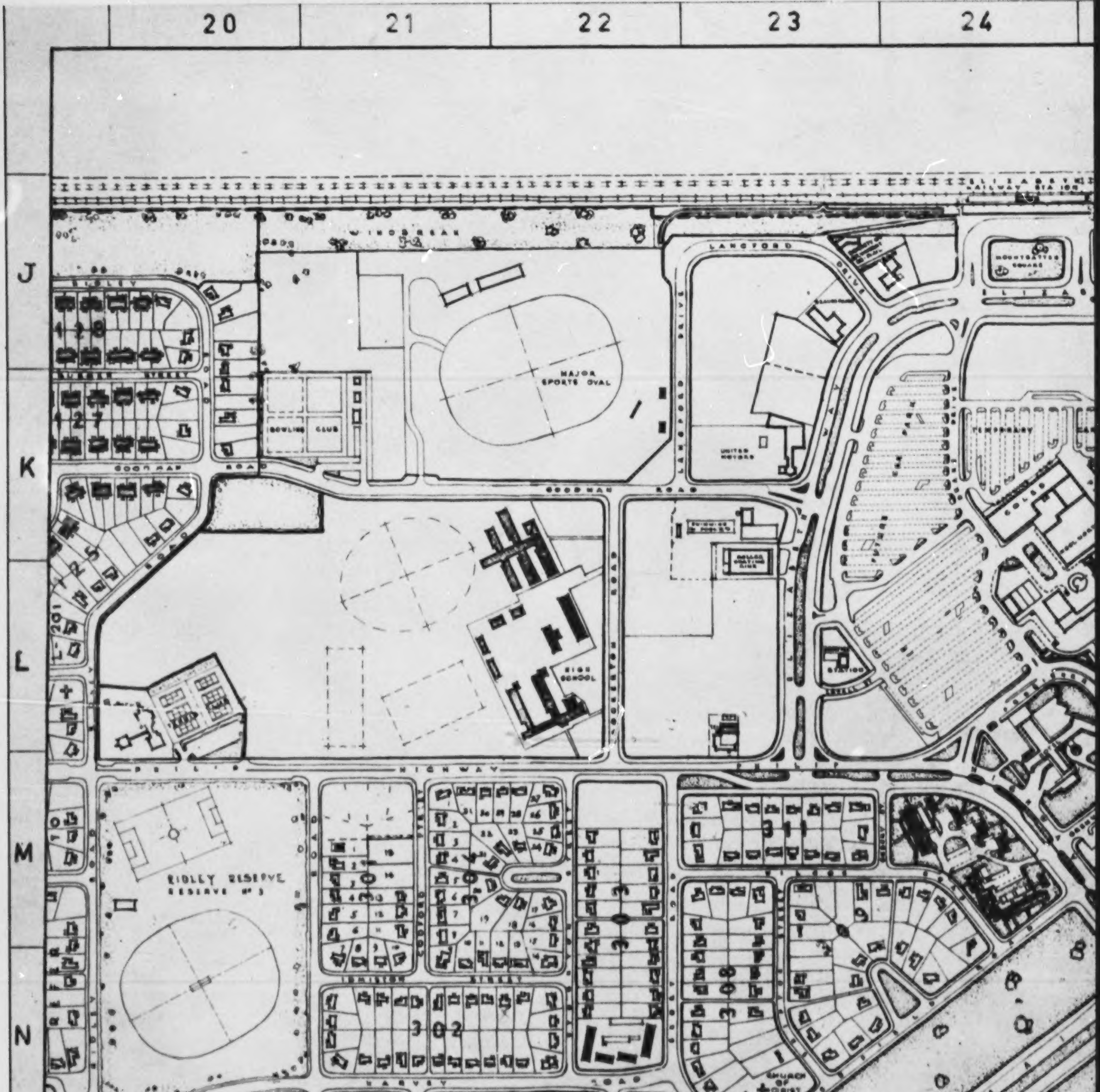

ELIZABETH
TOWN CENTRE
Scale of Feet
S.A.H.T. 5-265-TC.
REVISED 1-9-71
WAY
GILLINGHAM ROAD
WINTERSLOW ROAD
WOODFORD ROAD
YMCA
ST. JOHN COUNCIL
FIRE BRIGADE
ELIZABETH WAY
CHURCH OF ENGLAND SITE
DRIVE
WINDSOR GREEN
STREET
PRINCE CHARLES
ANDREW
FROBISHER
STREET
ROAD
RESERVE NO. 8
NORTH ROAD
MAIN
N
LEGEND
1 DELICATESSEN, CAFE, MILK BAR
2 GREENGROCER
3 OPTICIAN, HEARING AIDS & CAMERA CONSULTANTS
4 BUTCHER
5 6 7 GENERAL DRAPER & CLOTHING
8 FISH SHOP
9 10 GIFTS, TOYS, STATIONERY
11 BABIES & CHILDREN OUTFITTERS.
12 JEWELLER & WATCHMAKER.
13 SPORTING GOODS, CRAFTS, HOBBIES.
14 LINGERIE & SPORTSWEAR
15 P.B.A. OFFICE
15 LADIES FASHIONS
16 FLORIST
17 PHOTOGRAPHER
18 ESTATE AGENT
19 DRY CLEANER
20 ELECTRICAL
21 COFFEE LOUNGE
22 MENS & BOYS WEAR
23 NEWS AGENT, RECORDS & SPORTING GOODS
24 CYCLES
25 RUBBER STORE
26 FABRICS
27 LADIES SHOES
28 29 30 RADIO & ELECTRICAL
31 TRAVEL AGENCY
32 MUTUAL HOSPITAL ASSOC.
33 LADIES REST ROOM & TOILET
34 PETS & PETS SUPPLIES
35 GENT'S HAIRDRESSER & TOBACCONIST
36 37 DELICATESSEN
38 TAB. AGENCY
39 MILK & HEALTH FOOD
40 LADIES HAIRDRESSER
41 YOUTHS & YOUNG MENS WEAR
42 FOOTWEAR
43 CHEMIST
44 ELECTRICAL
45 HARDWARE
46 LADIES APPAREL
47 GOURMET
48 49 FURNITURE & HOUSEHOLD FURNISHINGS
50 MOTOR ACCESSORIES
51 52 BRIDAL WEAR & MILLINERY
52A TRUST RENT OFFICE
53 ART GALLERY & GIFTS
54 YOUNG MOD BOUTIQUE
55 GREENGROCER
56 BUTCHER
57 EXTENDED HOURS CHEMIST
FIRST FLOOR
ABOVE
35-37 OFFICE & EDUCATIONAL BOOKSHOP
18-32 BILLIARD SALOON
23-27 DANCING ACADEMY
30-37 OFFICES & PROFESSIONAL ROOMS
45-48 OFFICES & PROFESSIONAL ROOMS
50 0 50 100 150
METRES

Figure 12.5


20
21
22
23
24
J
K
L
M
N
LANGFORD
MOUNTBATTEN SQUARE
ELIZA
128
127
125
MAJOR SPORTS OVAL
BOWLING CLUB
UNITED MOTORS
GOODMAN ROAD
HIGH SCHOOL
STATION
HIGHWAY
RIDLEY RESERVE
RESERVE No 3
302
303
308
311
HARVEY
ROAD
RESERVE No 4
RIDLEY RESERVE
CHURCH OF CHRIST
203

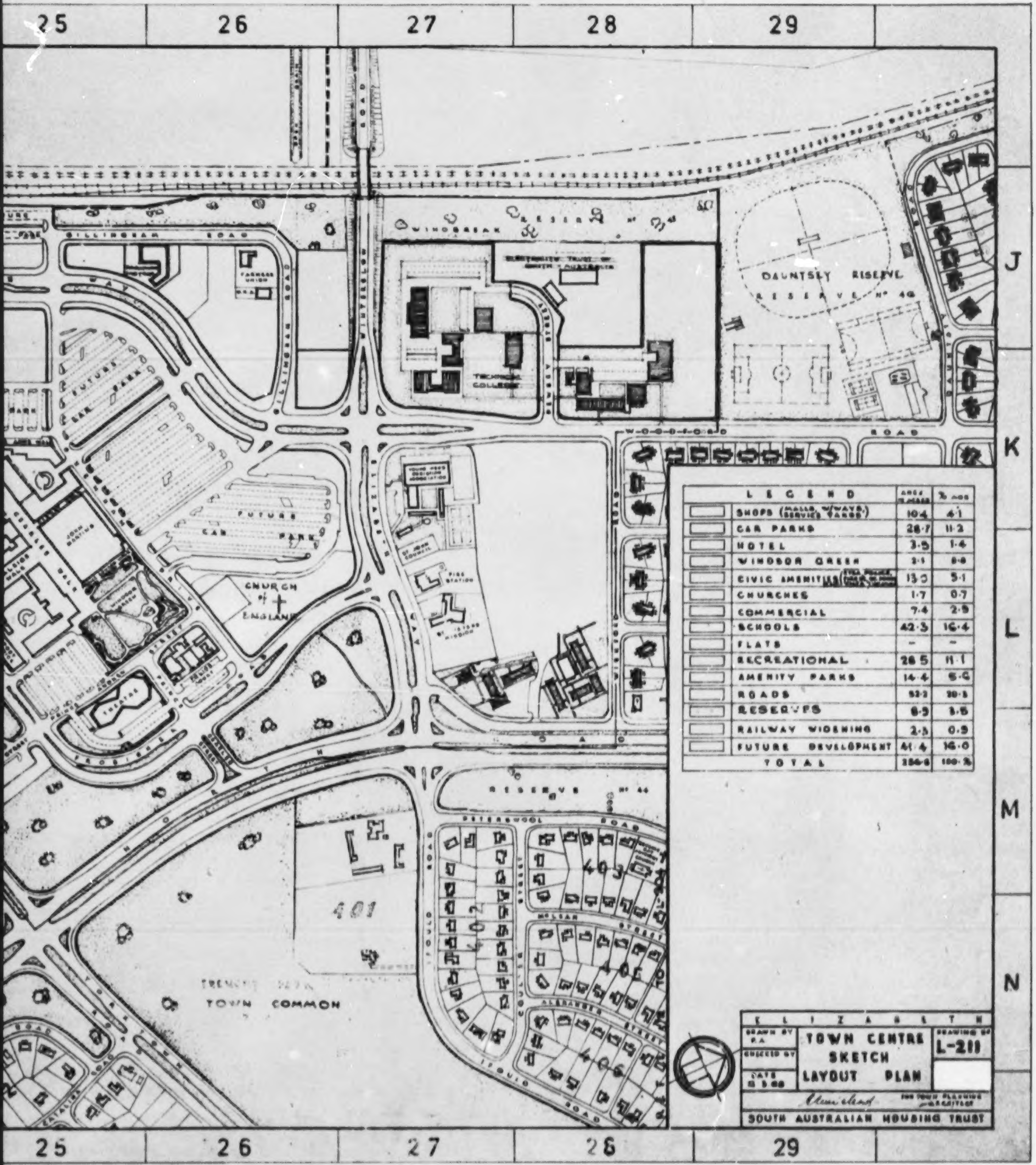

25
26
27
28
29
J
K
L
M
N
WINDBREAK
RESERVE
GILLINGHAM ROAD
FARMERS UNION
FUTURE CAR PARK
TECHNICAL COLLEGE
ELECTRICITY TRUST OF SOUTH AUSTRALIA
DAUNTSEY RESERVE
RESERVE No 46
WOODFORD ROAD
FUTURE CAR PARK
CHURCH of ENGLAND
FIRE STATION
ST JOHN COUNCIL
JOHN MARTINS
WINDSOR GREEN
THEATRE
PROMENADE
RESERVE No 44
PETERBOROUGH ROAD
401
402
403
405
406
TOWN COMMON
ALEXANDER STREET
LEGEND
AREA IN ACRES
% AGE
SHOPS (MALLS, W/WAYS, SERVICE YARDS) 10·4 4·1
CAR PARKS 28·7 11·2
HOTEL 3·5 1·4
WINDSOR GREEN 2·1 0·8
CIVIC AMENITIES 13·0 5·1
CHURCHES 1·7 0·7
COMMERCIAL 7·4 2·9
SCHOOLS 42·3 16·4
FLATS – –
RECREATIONAL 28·5 11·1
AMENITY PARKS 14·4 5·6
ROADS 52·2 20·3
RESERVES 8·9 3·5
RAILWAY WIDENING 2·3 0·9
FUTURE DEVELOPMENT 41·4 16·0
TOTAL 256·8 100 %
E L I Z A B E T H
DRAWN BY P.A
CHECKED BY
DATE
TOWN CENTRE SKETCH LAYOUT PLAN
DRAWING No L-211
FOR TOWN PLANNING ARCHITECT
SOUTH AUSTRALIAN HOUSING TRUST

Figure 12.6

100
50
0
100
200
300
METRES

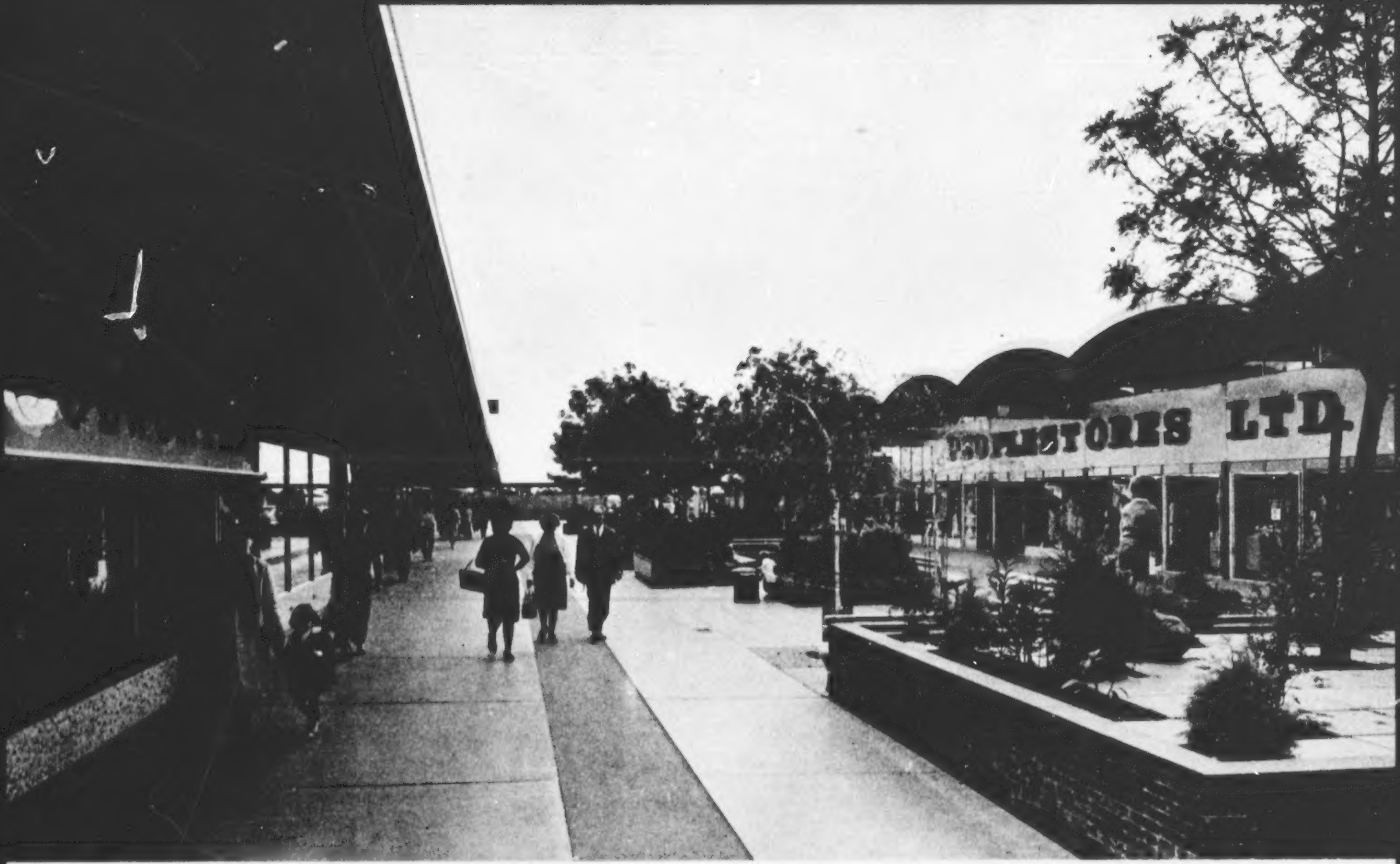


Figure 12.7 ***(S.A. Housing Trust and Darian Smith)***

— high school and technical college, various churches, swimming pool and roller skating rink, and facilities for a variety of other sports. An interesting part of this plan is that the car parking space provided for the shops may also be used to serve the sporting and recreational areas, which use it at different times of the day. Figure 12·7 shows part of the shopping mall in the Town Centre. Locate this photograph on figure 12·5, and work out the walking distance to the nearest car park. In an old-style city street one can, in theory, park just outside the shop, but in actual fact there may be no space available within several hundred metres. The Elizabeth parking areas are large enough to accommodate all likely shoppers at one time.

Figure 12·8 enables us to fit together the parts we have been examining. Pick out the Town Centre, the triangular housing area (including blocks of flats) which belongs to its neighbourhood, the high school, the Elizabeth South neighbourhood with its primary school and shopping centre, and the industrial area beyond. In what direction are we looking in the photograph? This is still only a small part of the whole planned city, as can be seen from figure 12·9, which shows the residential neighbourhoods and other industrial areas. Find where figure 12·8 fits on this plan. Note carefully the way in which the city spreads along the railway and the Main North Road, so that no neighbourhood is very far from either. The streets where people live are short and sometimes roundabout, preventing fast traffic where it is not wanted, but all are accessible to fast expressway-type roads to nearby towns. At the same time the inhabitants have the advantage of a long narrow city, in that they are never far from open country. Eastward the land rises into low hills, a large area of which is reserved for public use as the Para Wirra National Park.

Elizabeth is new. In 1955 it was open, flat, grazing land. Now it is a city of 50,000 people covering nearly 26 square kilometres. About 12,000 houses have been built in fifteen years. Eventually there will be 70,000 people on 36 square kilometres, and the extension will be northward towards Gawler (see figure 12·10). This kind of strip expansion of cities has the advantage of keeping all its people near open country, however large the city may grow. If it grows far enough,

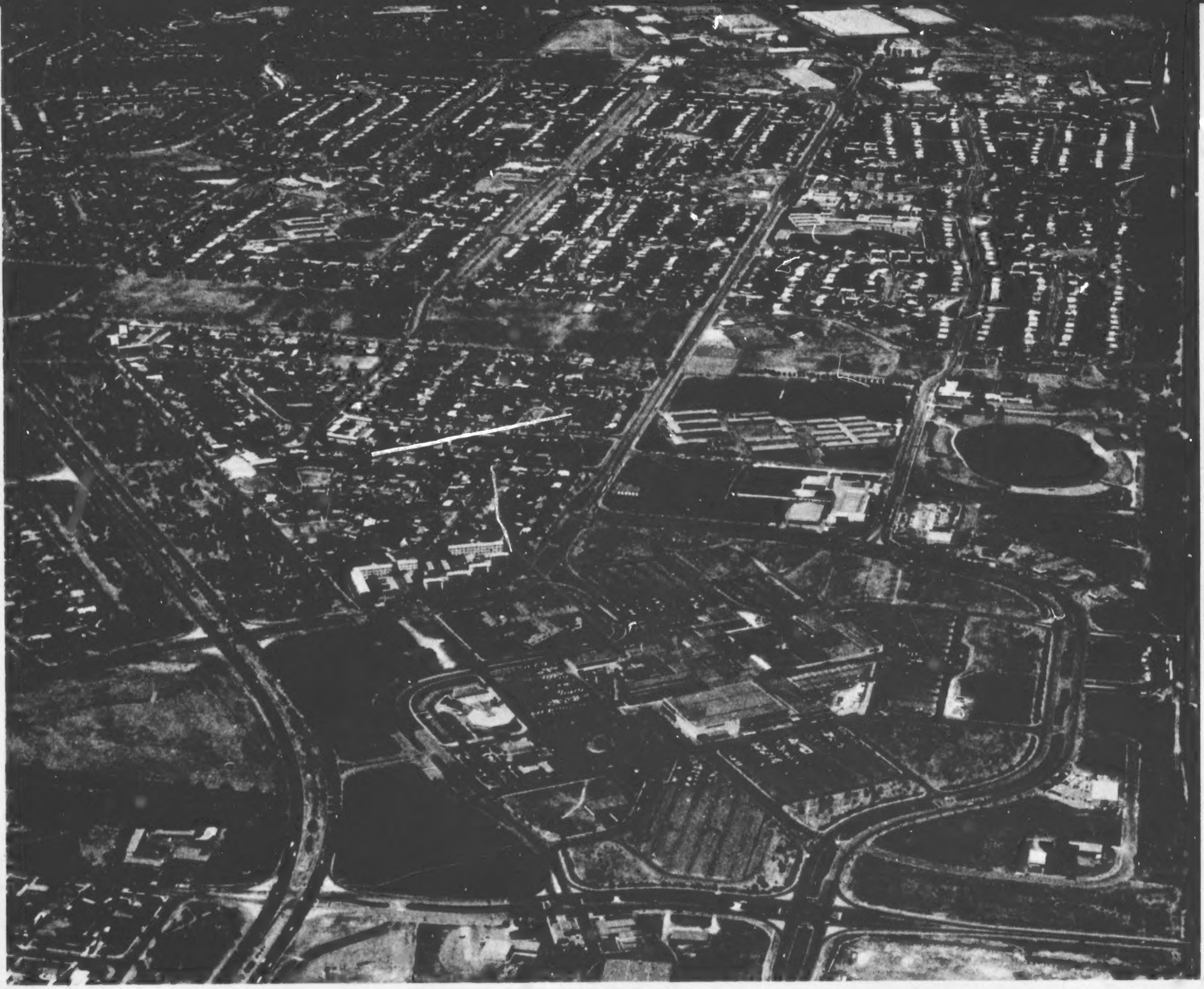
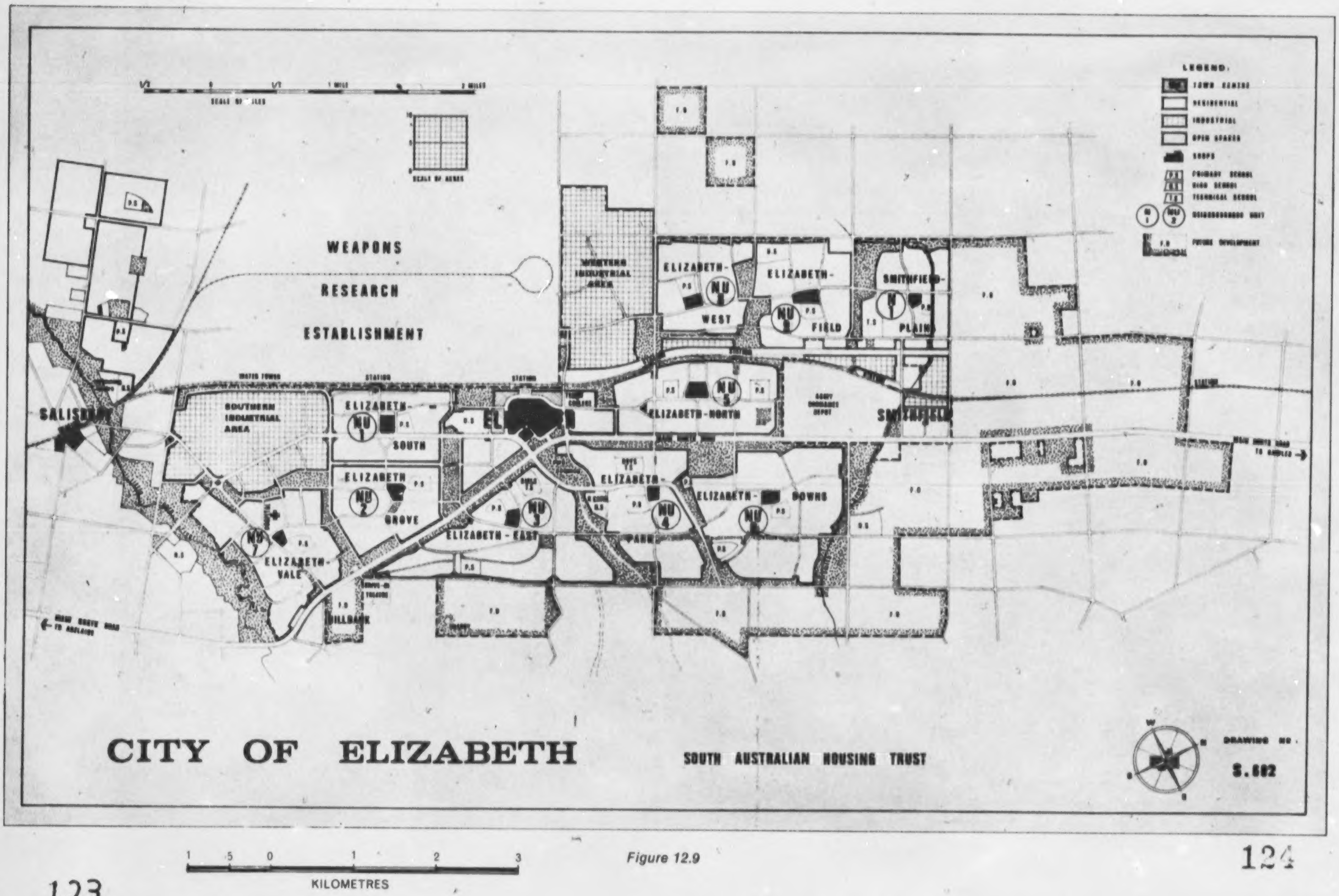


Figure 12.8 (S.A. Housing Trust and Darian Smith)



LEGEND:
TOWN CENTRE
RESIDENTIAL
INDUSTRIAL
OPEN SPACES
SHOPS
PRIMARY SCHOOL
HIGH SCHOOL
TECHNICAL SCHOOL
NEIGHBOURHOOD UNIT
FUTURE DEVELOPMENT
SCALE OF MILES
SCALE OF ACRES
WEAPONS RESEARCH ESTABLISHMENT
WESTERN INDUSTRIAL AREA
SALISBURY
WATER TOWER
STATION
SOUTHERN INDUSTRIAL AREA
ELIZABETH-SOUTH
ELIZABETH-GROVE
ELIZABETH-VALE
ELIZABETH-EAST
ELIZABETH-PARK
ELIZABETH-DOWNS
ELIZABETH-NORTH
ELIZABETH-WEST
ELIZABETH-FIELD
SMITHFIELD-PLAINS
SMITHFIELD
ARMY ORDNANCE DEPOT
ELIZABETH
HILLBANK
MAIN NORTH ROAD TO ADELAIDE
MAIN NORTH ROAD TO GAWLER
CITY OF ELIZABETH
SOUTH AUSTRALIAN HOUSING TRUST
DRAWING NO.
S.882
1 .5 0 1 2 3
KILOMETRES

Figure 12.9

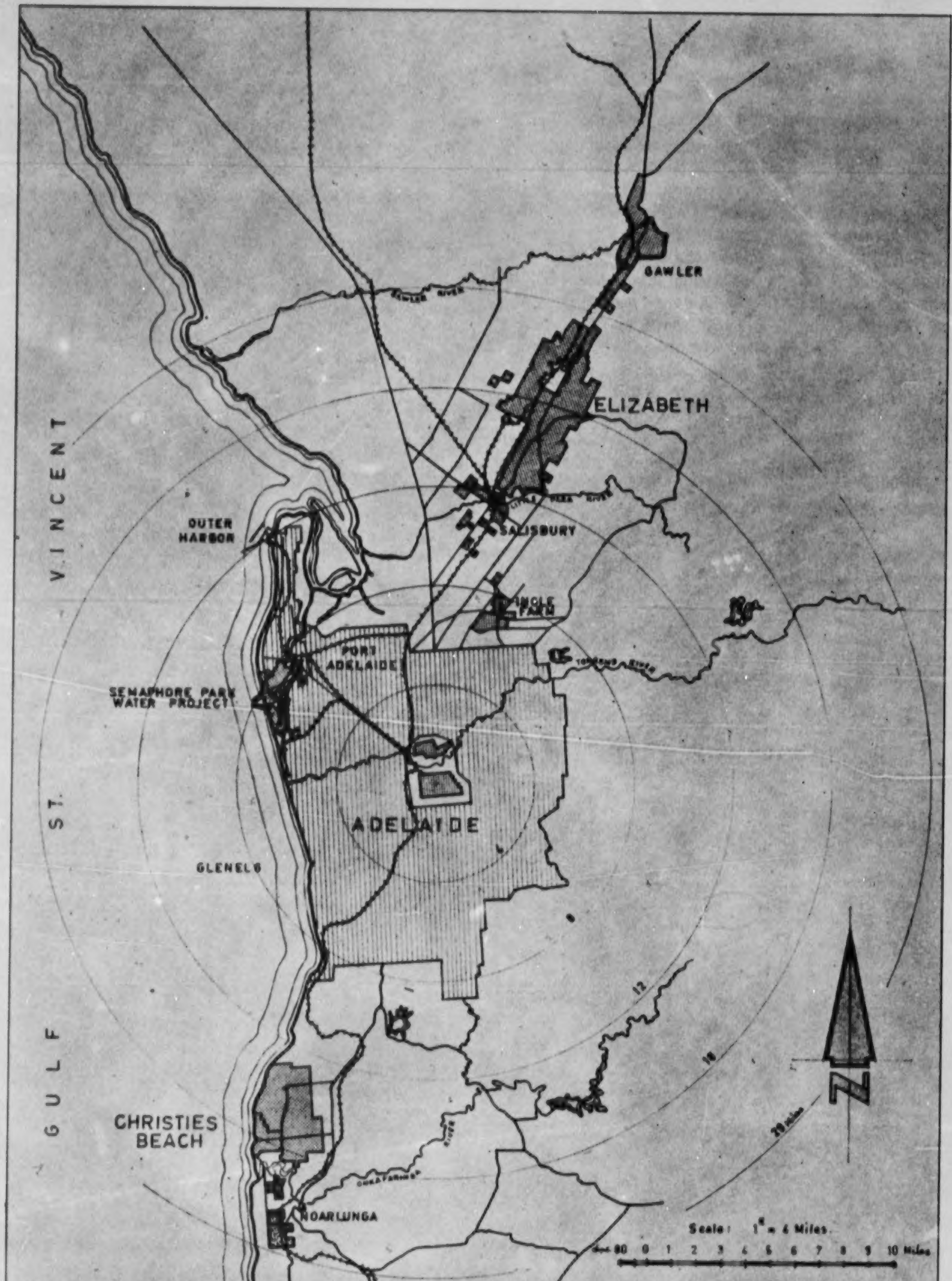

GAWLER
GAWLER RIVER
ELIZABETH
LITTLE PARA RIVER
SALISBURY
INGLE FARM
TORRENS RIVER
OUTER HARBOR
PORT ADELAIDE
SEMAPHORE PARK WATER PROJECT
ADELAIDE
GLENELG
GULF ST. VINCENT
CHRISTIES BEACH
ONKAPARINGA RIVER
NOARLUNGA
12
16
20 miles
N
Scale: 1" = 4 Miles
10 0 1 2 3 4 5 6 7 8 9 10 Miles
LOCATION PLAN
DRAWING NO. CBL-2
SOUTH AUSTRALIAN HOUSING TRUST
4 2 0 4 6 8 10 12
KILOMETRES

Figure 12.10

another town centre can be fitted into the plan, though in this case the existing town of Gawler will serve that purpose.

The planners and builders of Elizabeth were the South Australian Housing Trust. On the boundary of the area is the Weapons Research Establishment (see figure 12·9), which is one of the most important centres of its kind in the world. This was one of the factors which influenced the choice of site for the new town. The construction of houses in a new neighbourhood is sensible only if the people who live there have employment at a reasonable distance, have suitable road and rail communications with other towns, and adequate water, sewerage and electricity services. Therefore, very considerable cooperation was necessary between the Housing Trust and the other bodies concerned. Now that the plan is a reality, Elizabeth is becoming a major manufacturing centre which is at the same time a pleasant place in which to live.

FURTHER ACTIVITIES

Draw up a chart to compare the ways in which Elizabeth differs from your own home area as far as layout is concerned. You may like to use the following headings for your comparative chart:

- Size of town:
  - Population
  - Area
- Age of town
- Nature of streets:
  - Width
  - Double-tracked?
  - Pattern
  - Surfacing
- Parking provisions
- Number of shopping centres
- Range of industry*
- Means of transport

**Your local Universal Business Directory can tell you exactly what industries are represented*

13

Sale: a large-scale rural neighbourhood

Figures 13·1, 13·7, 13·9 and 13·10 give you evidence of the importance of Sale in relation to the land around it. What is a neighbourhood? A great deal can be learned about a neighbourhood and how it works as a system by examining its functions. These are the tasks that may be performed in a central place for its own people, and for the population living in the countryside. The countryside in this sense would include smaller urban centres as well as rural area or open countryside. We are going to study the links between the Gippsland city of Sale, a large neighbourhood, and its countryside. Some of the functions which Sale people perform will be examined.

Sale (population 10,000) has an influence over much of Central Gippsland, and attracts clients to a range of functions varying from retail shopping, saleyards and schools, to sports facilities, hospitals, government offices and church administration. Some of these functions have an area of influence barely extending beyond the Sale city limits. Others, like the church and government administrations, extend their influence over the whole of Gippsland. Sale's area of influence, also known as a *hinterland*, represents an average of the area of influence of each function. While this idea is fairly easy to understand, the actual extent of the hinterland is difficult to define. Furthermore, it is not a set limit, but changes through time. Later we will discuss changes that are occurring in Sale's hinterland boundary.

Because the physical background — the relief, soils, vegetation and river systems — determines much as to how the hinterland will be settled, we will first survey these aspects. Locate Sale in your atlas. How far is it from the sea? What is the height of the land around it? The average height of the city above sea level is only 10 metres. Thirteen kilometres to the north the Macalister River joins the Thomson, while 5 kilometres to the south this system joins the Latrobe, and flows into Lake Wellington. The surrounds of Sale are often subjected to severe floods. What benefits may be brought by flooding? Over 20 per cent of the flat land can be irrigated, mainly from waters stored in the Glenmaggie Reservoir on the Macalister River. Without this irrigation, the area would not be nearly as productive, for the annual average rainfall is as low as 560 mm and serious moisture shortages can occur in summer and autumn.

The extremely productive irrigated flood plains along the district rivers are the core of Sale's hinterland. The greater number of the hinterland population live on farms and in villages and towns within this core area.

Sale's hinterland

Despite the recent discoveries of oil and gas in Bass Strait, and the establishment of treatment plants for these materials at Longford 8 km south of Sale (figure 13·7), the prosperity of the city depends heavily on farming. Dairying is the most important farm industry, irrigation ensuring year-round pasture growth. Fat lambs and beef cattle are other important products of the irrigated lands. Recently there has been a sharp increase in the output of vegetables such as tomatoes and peas to feed into Melbourne processing plants.

Away from the intensively farmed irrigation lands, sheep and beef cattle are the main forms of production, but the farms are larger and the output per hectare lower than on the best country. At present there is a substantial development of the coastlands south of Sale. Light timber and scrub are being cleared, trace elements added to the soil, and pastures planted. While this area will never be as productive as the river plains, the new developments are important to Sale because they are adding to the output of the southern zone of its hinterland.

Links between farms and Sale

Examine figure 13·2. If you were to take a walk along Raymond Street, the core of Sale's business district, you would find many shops, offices and other services which are not directly needed by its own population. Why is this so? The most obvious of these services are the stock and station agents.

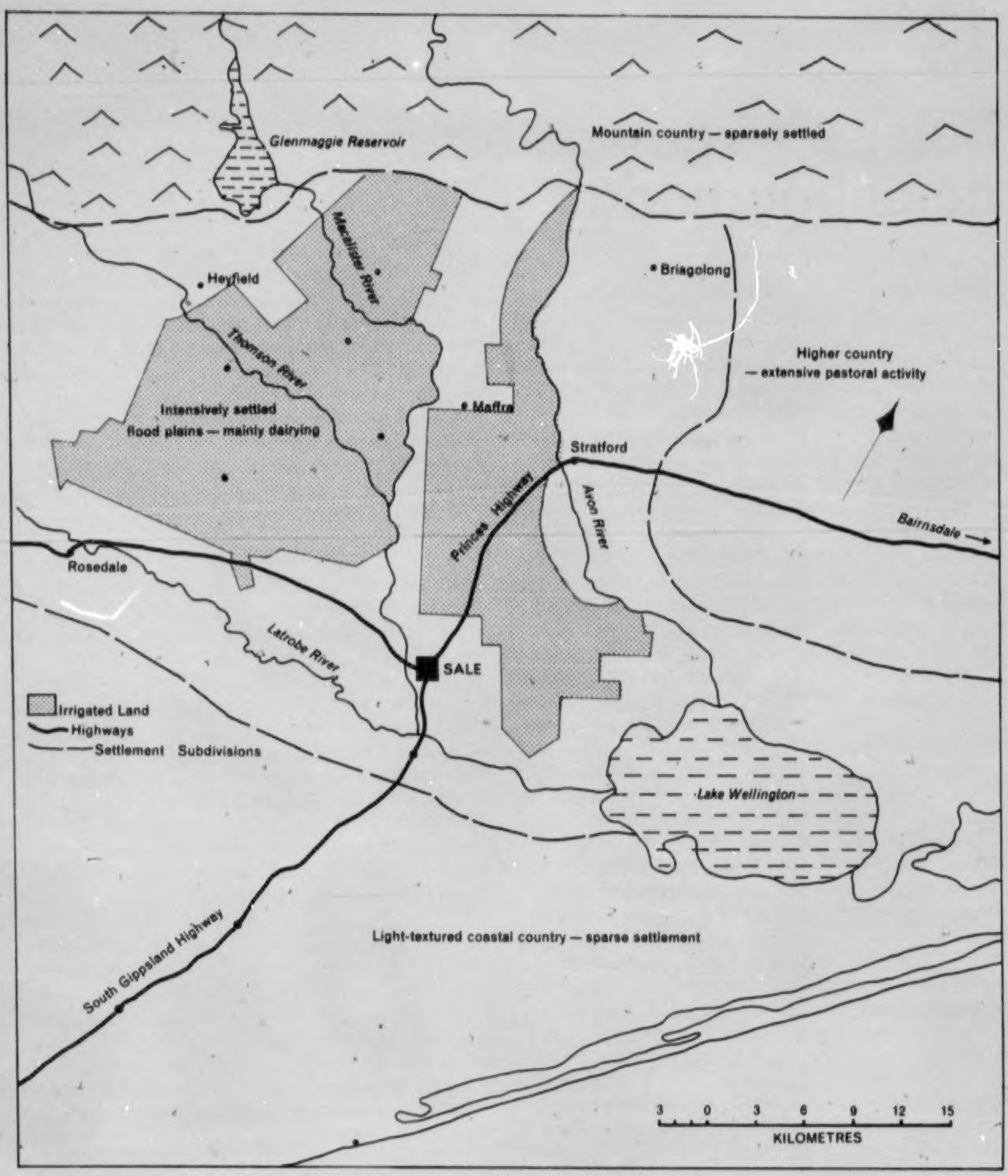

Glenmaggie Reservoir
Mountain country — sparsely settled
Macalister River
Heyfield
Briagolong
Thomson River
Higher country
— extensive pastoral activity
Intensively settled
flood plains — mainly dairying
Maffra
Stratford
Princes Highway
Avon River
Bairnsdale →
Rosedale
Latrobe River
SALE
Irrigated Land
Highways
Settlement Subdivisions
Lake Wellington
Light-textured coastal country — sparse settlement
South Gippsland Highway
3 0 3 6 9 12 15
KILOMETRES

Figure 13.1: Sale's hinterland—major settlement and physical characteristics

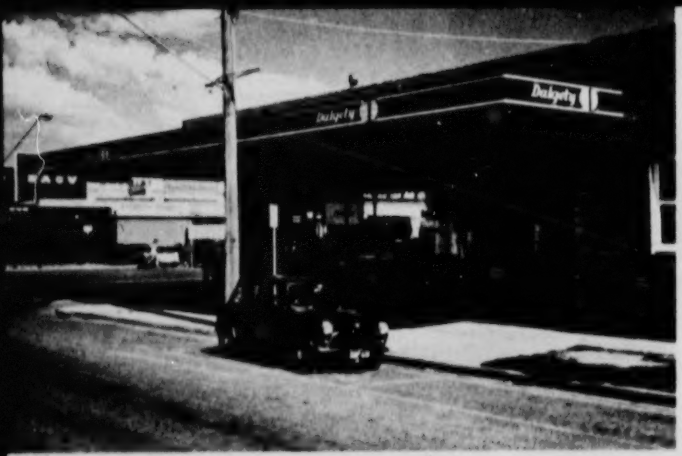


Figure 13.2: The main-street office and store of one of Sale's numerous stock and station agents

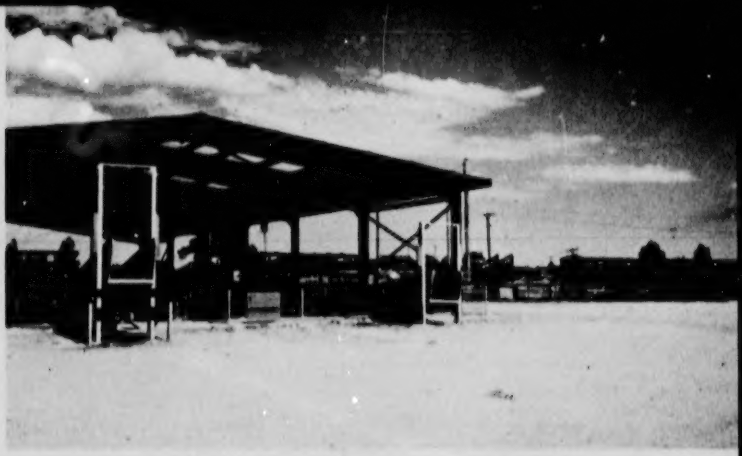


Figure 13.3: Part of the Sale municipal saleyards. The stock agents pay a fee to use these for auctions. The truck loading ramps and special rail siding can be clearly seen

There are nine of these firms, and their clients (both buying and selling) extend from Melbourne to south-eastern New South Wales. But there are others such as farm produce merchants, farm machinery agents, and the offices of oil drilling or exploration companies. In what ways is figure 13·3 linked with Sale's hinterland?

The Sale neighbourhood includes approximately 14,000 people in the surrounding countryside, in addition to its own population of 10,000. Many of these 14,000 people have needs which are vastly different from those of the typical 'townie' (urban dweller).

Imagine a market town as being a central point, or the focus of activity in an area known as the hinterland. This idea is summed up in figure 13·4. There will be a number of small urban centres in the hinterland. These will have close contact with the market town. In addition there will be interaction (direct links) between rural areas in the hinterland and the market town. What form would this interaction take? Figures 13·5 and 13·6 give further evidence of the nature of the interaction. Once again the market town is shown as the focus of the district. Within the outer circle which is the hinterland boundary, there are hundreds of farms. Many of these farmers have a direct two-way link with the market town. The market town provides *farm inputs* from its shops, offices and produce stores. Such items as farm machinery, seed, fertiliser, fencing and a host of other farm needs are available from business people who are geared to cater for the district farmers. They have usually purchased these inputs from a distant manufacturing centre (Melbourne or beyond), and imported them by road or rail. In this role the market town acts as a *distribution centre* for the countryside.

In addition, there is a movement of farm produce (*farm outputs*) in to the market centre. In the Sale area this consists mainly of stock. The council-operated saleyards sold a total of 193,000 head, mainly sheep and cattle, in the year ended 30 September 1970. The saleyards and trucking facilities in Sale are a valuable link between the farms of its hinterland and distant consuming centres, notably Melbourne. Ninety per cent of the cattle and 80 per cent of the sheep are sold for slaughter. Of this proportion, three-quarters are slaughtered in Melbourne, and one-quarter locally.

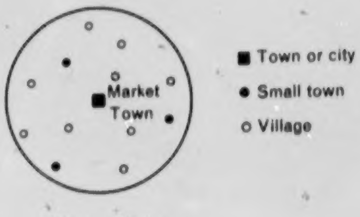


Figure 13.4

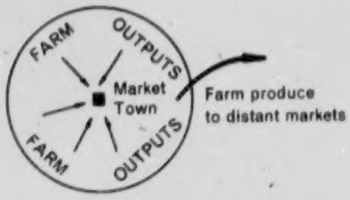


Figure 13.5: The market town as a collecting centre

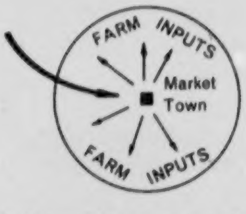


Figure 13.6: The market town as a distribution centre

In this role, Sale acts as a *collecting centre* for its hinterland. Farm produce is brought in, sold, sometimes processed, and then forwarded by road or rail to a distant market outside the region.

But the association between Sale and its hinterland goes further than linkage between farm and market centre. In the words of the *City of Sale Overall Planning Review:* 'Many of the 14,000 population in the tributary area depend on the city for employment, recreation, education, culture, and a number of important services.' These aspects will be examined in the last part of this study.

Sale and other centres in the hinterland

See figure 13·7. One of the interesting features of Sale's position is the influence it has over nearby smaller towns and villages. With the development of good road systems and the widespread use of fast automobiles, the tendency is now for farmers to go directly to the centre with the greatest range of functions in the area. In the Central Gippsland area, this clearly is Sale. There is a dense grid of bitumen roads in the irrigated areas, and a farmer living at Denison, for example, would frequently travel the 26 km to Sale rather than the 8 km to his nearest centre, Heyfield. The longer trip would only take 20-25 minutes over the plains. Denison is only a rural district — it is not a neighbourhood, and has no shops at all. It is possible that Heyfield (pop. 1,900) would be used at times for *convenience shopping* — that is, for daily requirements such as foodstuffs. Sale, on the other hand, would be used for *comparison shopping* — for items other than daily requirements (furniture, hardware and clothing). It would also be used for *services* ranging from law through insurance to hairdressing. While some of these services are available in the smaller centres, there is a wider range of such services in Sale, and these are a magnet to the district population. Often a person, having gone to Sale especially for a service or comparison item, will do convenience shopping there too.

The further result of this is that smaller centres like Stratford are losing population, and there is evidence of decline in their 'main' streets. The villages like Kilmany or Boisdale are in sharp decline. They have far fewer functions than they did 30 years ago. Perhaps a town like Maffra (pop. 4,500) can continue to attract custom because of its reasonable range of functions.

The decline of smaller centres in country districts is part of a state-wide trend — perhaps even a world-wide one — and is not limited to Sale's hinterland. Table 13·1 has been designed to show some typical functions of centres of various sizes in Central Gippsland. Study it. For what would a person living in Stratford travel to Sale?

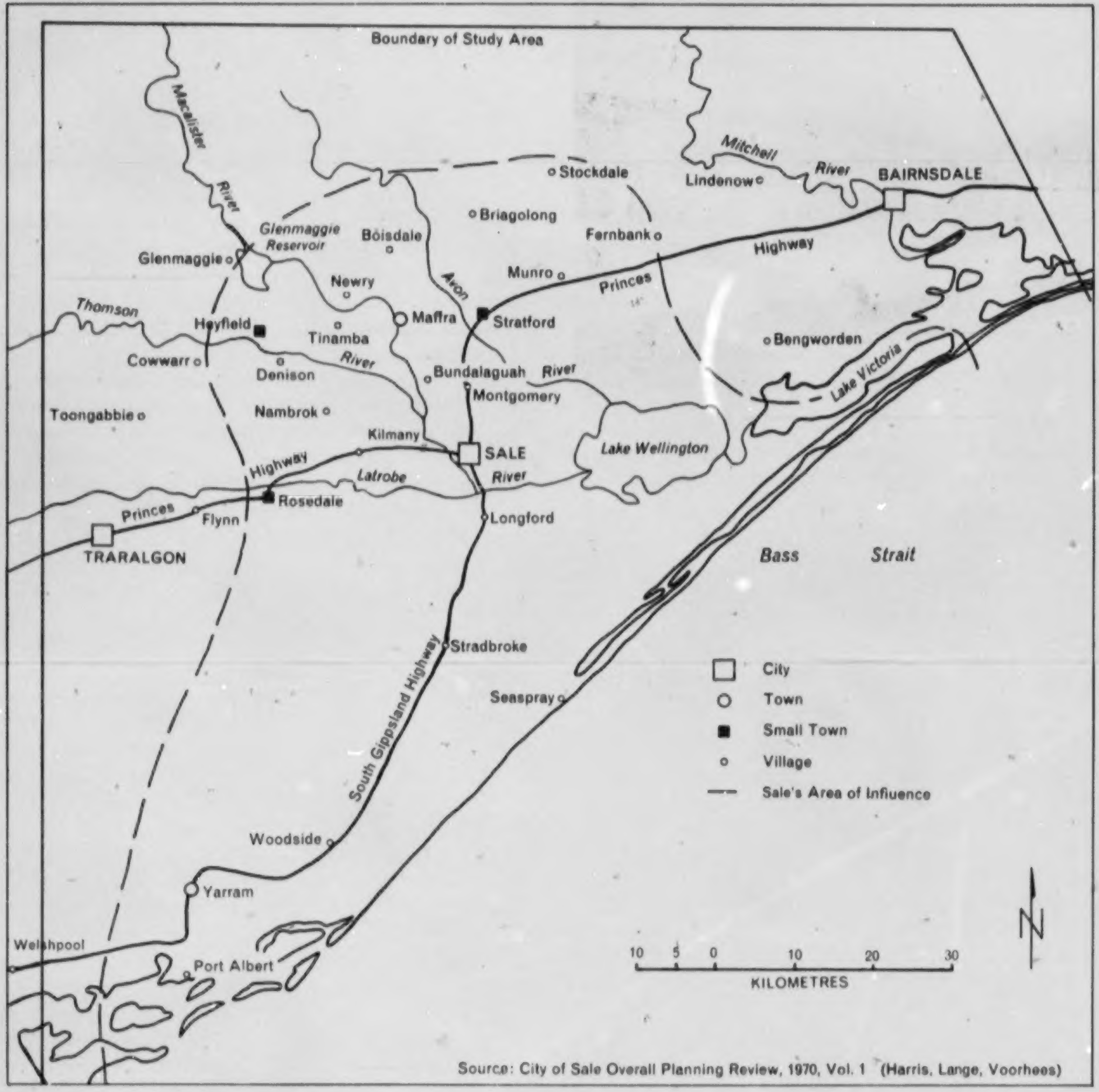
A study of a single trade area

The area from which a store or service draws its customers is called its *trade area*. Because Sale is a very important retail centre, especially for comparison shopping, a large and well established department store, W. D. Leslie Pty Ltd (figure 13·8), was selected as representative of the city's stores, and the sources of its accounts were examined. These are outlined in figure 13·9.

The extent of a store's trade area is determined by a number of factors. One of these is the location of similar stores in other Gippsland centres. Another is sheer distance from Sale. Both are obvious factors in limiting Leslie's trade area. To the east, Bairnsdale (pop. 8,500) has two large department stores. The presence of good shopping facilities in the Latrobe Valley towns to the west provides a limitation in that direction. To the south there is no opposition, while in the south-west there is evidence that there is a significant expansion of the trade area in the Yarram/Alberton area. Yarram (pop. 3,000) has only a moderate range of comparison shopping facilities. It will probably lose trade to Sale as people are now prepared to travel longer distances to shop.

The core area of support for Leslie's, and for all Sale retailers, lies within a 25 km radius. Examine carefully the evidence provided in figure 13·9. What are the distances to the eight most important trade areas of Leslie's? The store also draws large numbers of customers from Stratford and Rosedale. The Rosedale support is interesting because Traralgon (pop. 16,000) is closer than Sale; however, it has a lesser range of retail and service functions. North of Maffra, the densely populated dairying lands channel a large proportion of their trade through Maffra, and so Leslie's influence in that zone is somewhat reduced.

But while we can make informed guesses on factors which help determine a trade area, there still remains the problem of accurately locating its boundary line. This can only be done by examining the influence of competitor stores in centres to the east and west of Sale. Evidence points to a sharp decline in Sale's influence immediately east of Stratford. Why is this so? Check with figure 13·1 for further evidence. Leslie's only had 25 accounts in the large Munro/Fernbank area. To the west, the Flynn district only provided one account. Clearly Flynn residents are geared to trading in Traralgon, only 13 km distant.


Boundary of Study Area
Macalister River
Glenmaggie Reservoir
Glenmaggie
Boisdale
Briagolong
Stockdale
Mitchell River
Lindenow
BAIRNSDALE
Fernbank
Munro
Princes Highway
Newry
Avon
Thomson
Heyfield
Tinamba
Maffra
Stratford
Cowwarr
Denison
River
Bundalaguah
River
Montgomery
Bengworden
Lake Victoria
Toongabbie
Nambrok
Kilmany
SALE
Lake Wellington
Highway
Latrobe River
Princes
Flynn
Rosedale
Longford
TRARALGON
Bass Strait
Stradbroke
South Gippsland Highway
Seaspray
City
Town
Small Town
Village
Sale's Area of Influence
Woodside
Yarram
Welshpool
Port Albert
10 5 0 10 20 30
KILOMETRES
N

Source: City of Sale Overall Planning Review, 1970, Vol. 1 (Harris, Lange, Voorhees)

Figure 13.7: Sale's hinterland

Table 13 1: Sale hinterland — functions of selected centres

	Schools: Prim./Sec.	Tech.	Post Office	Hall	Bank Branch	Shopping	Hotel	Motel	Caravan Park	Church	Rail Station	Govt Dept	Court House	Rec. Facilities	Airfield	Swimming Pool	Water Supply	Sewerage	Saleyards	Stock Agents	Insurance	Newspaper	Radio/TV	Fire Brigade (urban)	Police Station	Hospital	Theatre	Library	Kindergarten
Sale	P S	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maffra	P S		●	●	●	●	●		●	●	●	●	●	●		●	●	●	●	●	●	●		●	●	●		●	●
Stratford	P		●	●	●	●	●		●	●	●			●			●		●		●			●	●				●
Tinamba			●	●		●	●			●	●								●										
Boisdale	P S		●	●		●				●				●															
Nambrok	P		●	●		●								●															

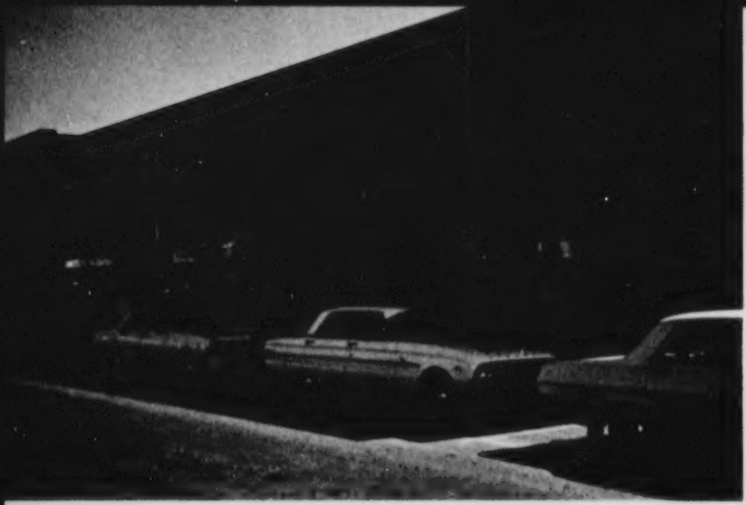


Figure 13.8: This modern department store attracts customers from a radius of up to 80 km from Sale

Despite the practical problems, it is possible to provide a trade area boundary for Leslie's with reasonable accuracy (see figure 13·9).

Each of Sale's many functions will have a trade area or area of influence. Obviously it is beyond the scope of this work to detail them all. However, if a few are selected, it should be possible to observe the great differences which will exist in the trade areas of different functions, and as well provide a guide to the extent of the overall hinterland area.

But Sale's strongest links with its hinterland are with the farmers. The role of Sale as a centre for stock sales emphasises this point. Buyers at Sale markets come from Melbourne to Orbost and occasionally from southern New South Wales.

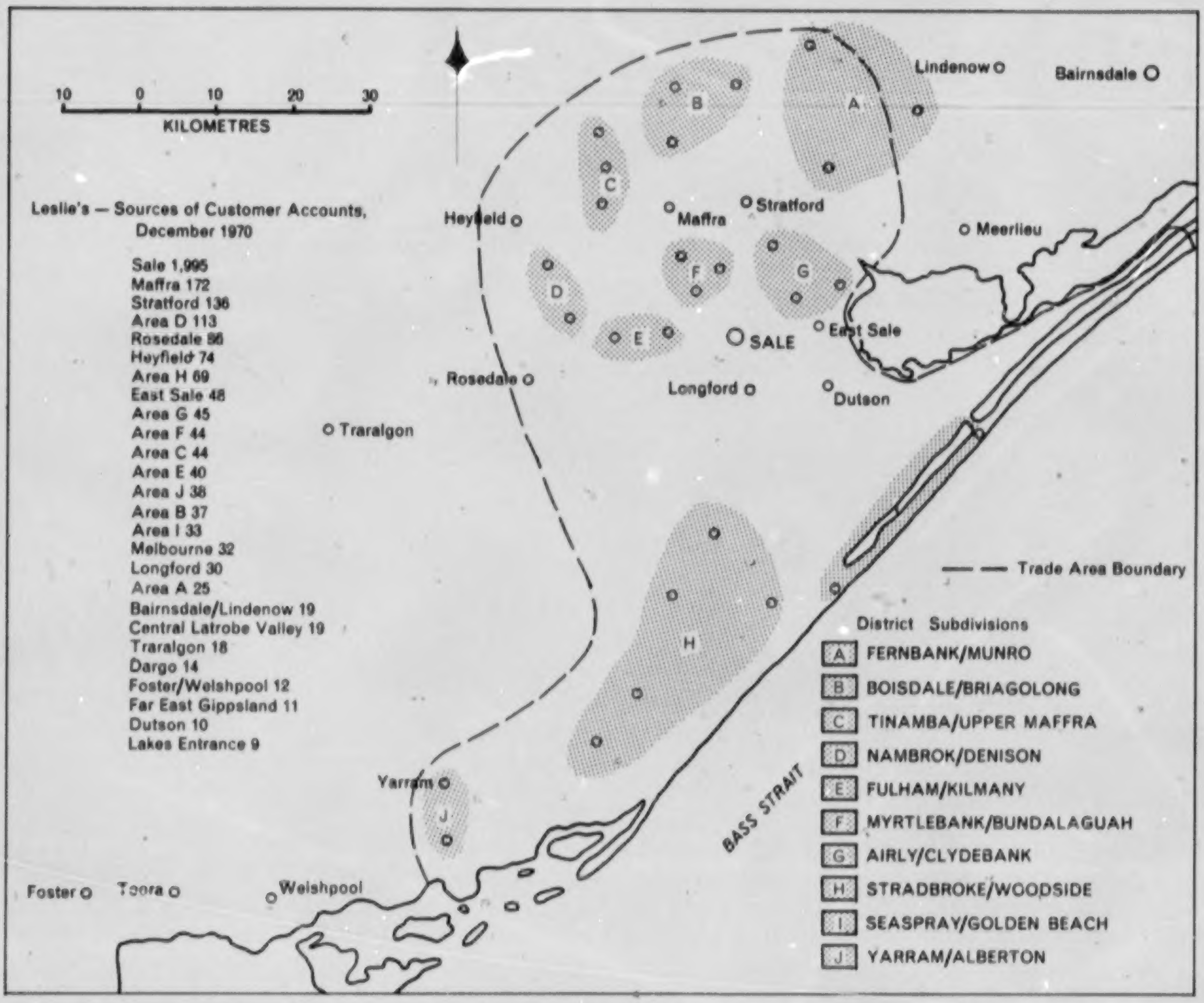
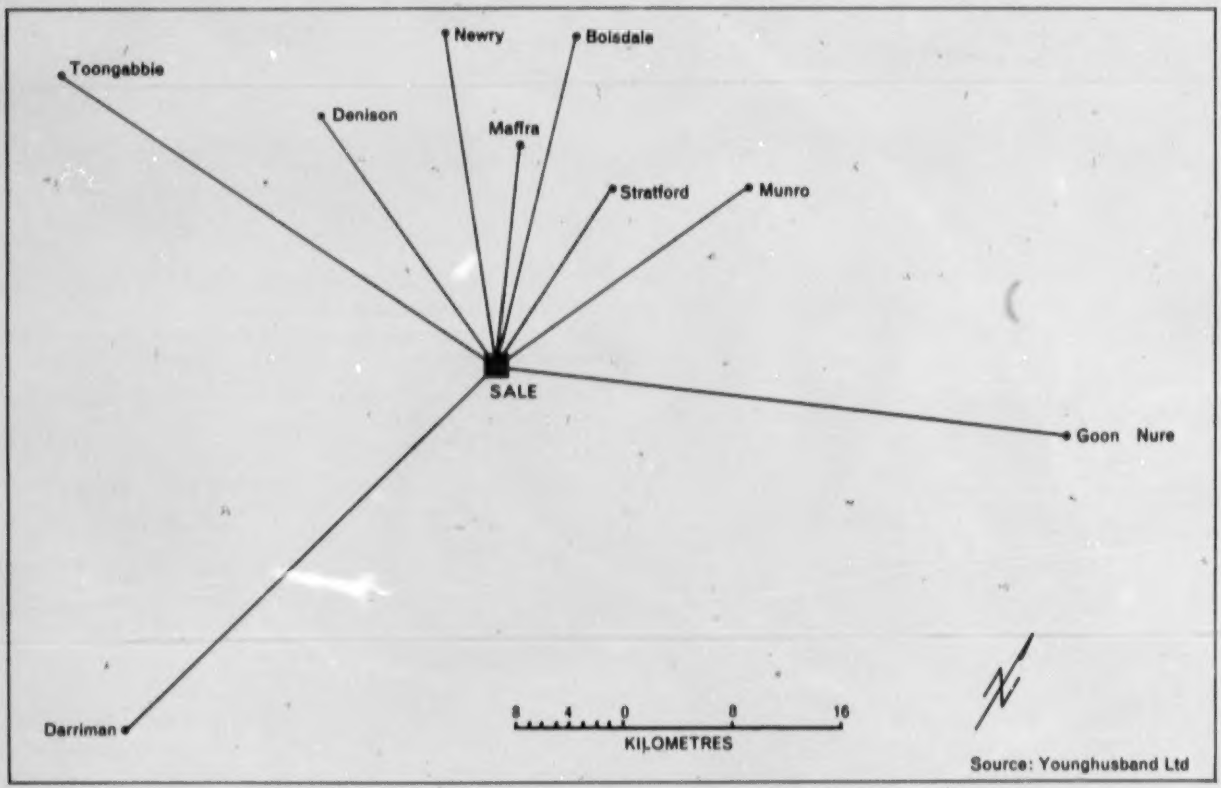

10 0 10 20 30
KILOMETRES
Leslie's — Sources of Customer Accounts, December 1970
Sale 1,995
Maffra 172
Stratford 136
Area D 113
Rosedale 86
Heyfield 74
Area H 69
East Sale 48
Area G 45
Area F 44
Area C 44
Area E 40
Area J 38
Area B 37
Area I 33
Melbourne 32
Longford 30
Area A 25
Bairnsdale/Lindenow 19
Central Latrobe Valley 19
Traralgon 18
Dargo 14
Foster/Welshpool 12
Far East Gippsland 11
Dutson 10
Lakes Entrance 9
Lindenow
Bairnsdale
A
B
C
D
E
F
G
H
J
Heyfield
Maffra
Stratford
Meerlieu
SALE
East Sale
Rosedale
Longford
Dutson
Traralgon
Yarram
Foster
Toora
Welshpool
BASS STRAIT
Trade Area Boundary
District Subdivisions
A FERNBANK/MUNRO
B BOISDALE/BRIAGOLONG
C TINAMBA/UPPER MAFFRA
D NAMBROK/DENISON
E FULHAM/KILMANY
F MYRTLEBANK/BUNDALAGUAH
G AIRLY/CLYDEBANK
H STRADBROKE/WOODSIDE
I SEASPRAY/GOLDEN BEACH
J YARRAM/ALBERTON

Figure 13.9: Leslie's department store—trade area. The shape of the trade area is almost identical to that of Sale's hinterland (see figure 13.7)



Source: Younghusband Ltd

Figure 13.10: Origin of store cattle for auction, Sale City Yards, 14 September 1970

Sellers generally come from a more limited area. Here again the position of competitors for the Sale stock trade is important. Bairnsdale, 74 km east by road, is a big auction centre; so is Dandenong, 177 km to the west.

The locations of suppliers to a special spring store-cattle sale on 14 September 1970 will give an indication of the extent of Sale's influence as a stock auction centre. Compare figure 13·10 with figure 13·9. What similarities can you see? As well, there were some local Sale suppliers to this auction. The pattern at such a sale is to forward the stock by road. After the sale, some consignments go to Melbourne by rail. Road transport is still important, however, in after-sale movement.

Despite Sale's strong links with the land, there are many functions which help shape its hinterland which are not connected with farms. One of these is the Gippsland Base Hospital. Its specialised medical facilities attract patients from many parts of Gippsland, but mainly from the central and eastern districts. Here again the location of base hospitals at Traralgon and Warragul is an important factor. Figure 13·11, the statistics for which have been compiled on the basis of municipality (usually shire), shows that the Gippsland Base Hospital's area of influence extends east to the New South Wales border. Many patients are drawn from Orbost Shire, 160 km east. What differences can you see between the evidence on this map and that in figures 13·9 and 13·10? Why should such differences occur? (Figure 13·13 gives you further evidence.)

Sale is an important administrative centre for state and federal government departments. Some of these include:

- District Employment Office
- Lands Department
- No. 2 Division H.Q., East Gippsland Police District
- Supreme Court of Victoria
- Transport Regulation Board
- Postmaster-General's Department
- Electoral Registrar.

For the PMG, Sale is head office for the Gippsland District of the telecommunications (telephone) section, the territory for which extends from Warragul to the New South Wales border. The PMG engineering section covers the same area, and is based on Sale.

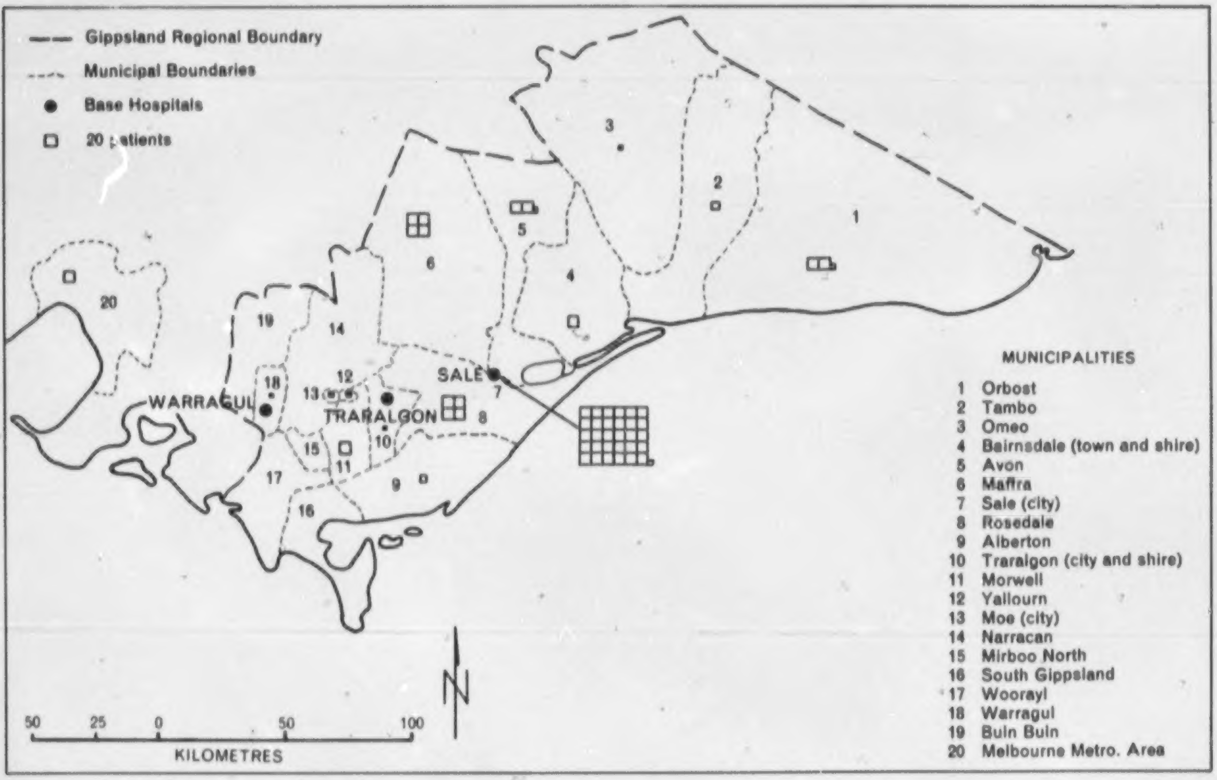

Gippsland Regional Boundary
Municipal Boundaries
Base Hospitals
20 patients
WARRAGUL
TRARALGON
SALE
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
50 25 0 50 100
KILOMETRES
N
MUNICIPALITIES
1 Orbost
2 Tambo
3 Omeo
4 Bairnsdale (town and shire)
5 Avon
6 Maffra
7 Sale (city)
8 Rosedale
9 Alberton
10 Traralgon (city and shire)
11 Morwell
12 Yallourn
13 Moe (city)
14 Narracan
15 Mirboo North
16 South Gippsland
17 Woorayl
18 Warragul
19 Buln Buln
20 Melbourne Metro. Area

Figure 13.11: Gippsland Base Hospital—sources of patients by municipality, 1969-70. Patients came from these municipalities:

Shire	*No. of Patients*	*No. of Days Total Stay*
Alberton	*11*	*1,336*
Avon	*47*	*453*
Bairnsdale	*22*	*434*
Maffra	*79*	*7,655*
Melbourne	*17*	*2,905*
Moe	*4*	*437*
Morwell	*9*	*497*
Omeo	*2*	*51*
Orbost	*46*	*4,346*
Rosedale	*85*	*1,415*
Sale	*607*	*15,937*
Tambo	*9*	*73*
Traralgon	*3*	*33*
Warragul	*3*	*398*
Yallourn	*9*	*424*
Interstate	*8*	*89*
Others	*12*	*485*
TOTALS	*973*	*36,968*

There are two radio stations — 3GI and 3TR, which have a wide coverage throughout Gippsland. There are four regional news sessions broadcast daily on 3GI which cover an area from Phillip Island and Pakenham east to the state border.

Sale is the only Gippsland centre to promote an ABC concert series. These are held regularly in the Memorial Hall. This hall is part of a cultural centre which draws patrons from a large area of central and east Gippsland.

In church organisation, both the Church of England and Roman Catholic Church have their diocesan headquarters in Sale. The diocese (administrative areas) cover all of Gippsland, and so extend Sale's influence to the limits of the region.

It is partly as a result of Sale's position as a centre of church organisation that it has developed as an educational centre, drawing students to some extent from all over Gippsland, but especially from an area within 30 km of the city. Sale has six secondary and three separate primary schools, although three of the secondary schools cater for primary pupils (see figure 13.14). It is in the field of secondary education that Sale has the greatest influence in the region, catering for

Table 13.2: Secondary school attendance, Sale

	SCHOOL	FULL TIME		PART TIME	TOTAL
		Day	Boarders		
	Sale High School	450	—	—	450
	Sale Technical School	926	—	460	1,386
Co-ed.	St Anne C.E.G.G.S.	140*	90	—	230
	Gippsland Grammar	122*	68	—	190
	St Patrick's College	260*	140	—	400
	Our Lady of Sion	216	64	—	280
	TOTAL	2,114	362	460	2,936

*Includes small numbers of primary pupils

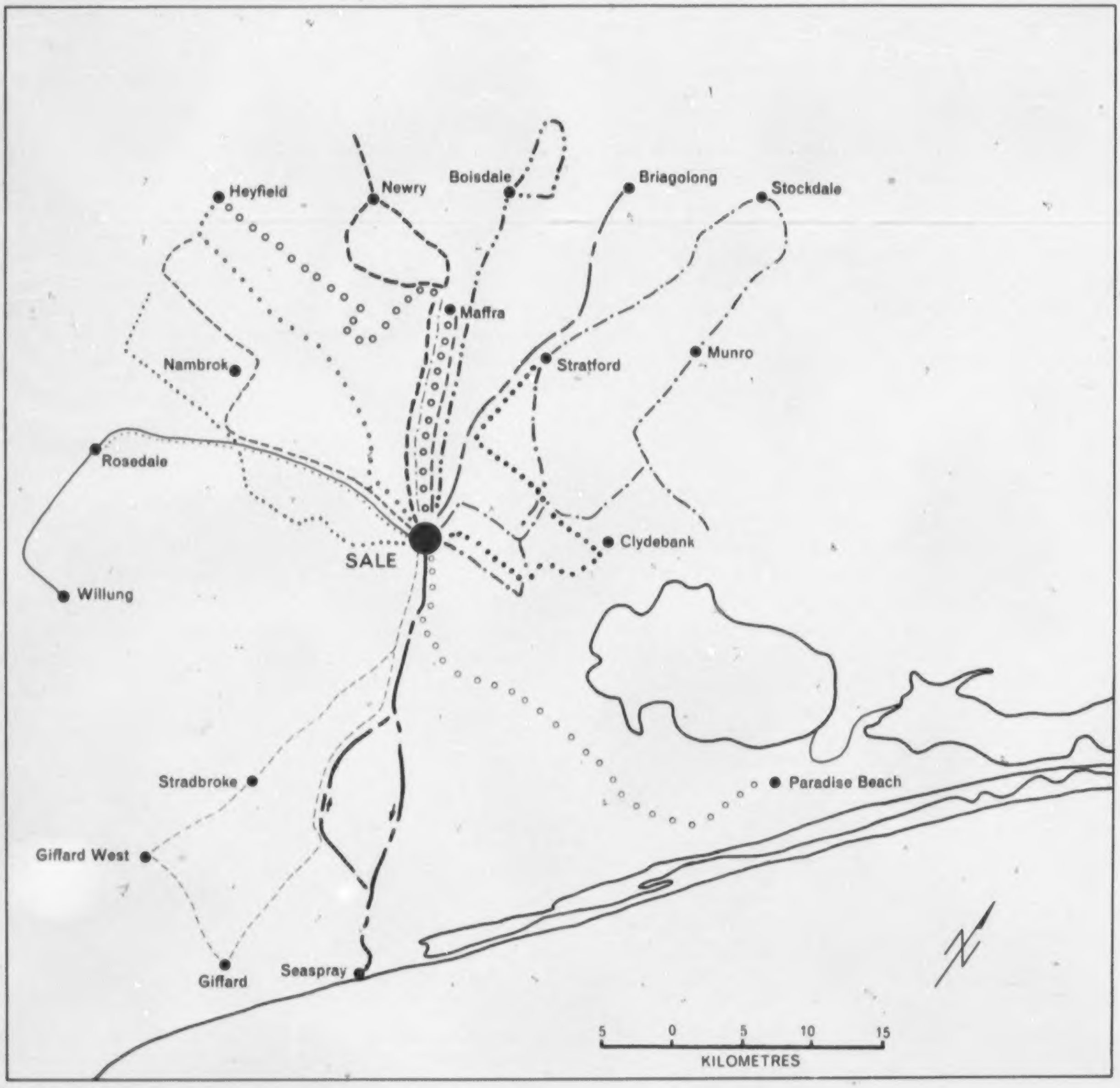

Heyfield
Newry
Boisdale
Briagolong
Stockdale
Maffra
Nambrok
Stratford
Munro
Rosedale
SALE
Clydebank
Willung
Stradbroke
Paradise Beach
Giffard West
Giffard
Seaspray
5
0
5
10
15
KILOMETRES

Figure 13.12: School bus routes, Sale district

Figure 13.13: This modern building is the Commonwealth Centre and houses several Commonwealth government departments. Included among these are the electoral offices, divisions of the Postmaster-General's Department, and the Commonwealth Employment Service

Figure 13.14: St Patrick's College, a Catholic boys' school, attracts 140 boarders from outside Sale

the needs of the smaller centres and rural areas where no secondary schools exist. See table 13·2.

Assuming that 2,700 of the total are secondary school pupils, this represents a number far greater than would normally attend secondary school in a city of 10,000. But of course Sale's schools serve more than its own population. Figure 13·12 shows the network of routes along which 24 buses bring pupils daily to Sale schools. In addition, there is a further number of pupils, mainly from more remote areas, who would board privately while attending state secondary schools. Twenty-five students from Dargo in remote north Gippsland attended Sale Technical School in 1970.

There are many lessons which might be learned from this topic, but perhaps the most important is that a neighbourhood like Sale — a market town — depends heavily for its prosperity on its countryside — on the district farms and smaller centres surrounding it. In turn, the valuable functions which Sale provides are an important asset to the countryside. Really, what has been stressed is interaction. Whether a farmer's son comes to Sale for a swim, or the farmer's wife comes to town to buy groceries, or the farmer sells cattle at the saleyards, all are part of the link. Sale's two-way links with its countryside are part of an absorbing study which should make the idea of large neighbourhoods more meaningful to you.

FURTHER ACTIVITIES

If you have not already covered the movement exercises outlined on page 98, it is suggested you do so now.

Plot on a base map of your neighbourhood the school bus routes used by members of your class.

Plot on another map the trading area for a large department store near your school. It is suggested you do this in much the same way as in figure 13·9. What comparisons can you make?

14

Are all urban neighbourhoods the same?

To many people, suburban areas of a modern city have a drab and unchanging appearance; however, the more careful observer is able to recognise features which give character to a suburb and thus distinguish it from other suburban areas within the city.

How can we examine an urban area to determine its characteristics, and what characteristics are we looking for? One method is to visit the suburb and make observations. An analysis of the data collected in the field enables us to develop some ideas about the area.

It is not always possible to gather this original information. Another method is to use other information such as photographs (from the air and from the ground), maps, statistics and graphs. You will use this *indirect* method in this inquiry into urban areas. After examining the different types of information, you should be able to give an answer to the question heading this inquiry.

Section A

One of the most useful ways of examining what an area looks like is to use vertical aerial photographs. You have seen such photographs before in this book. A lens or magnifying glass will help you to examine the photograph.

Look at figure 14.4 showing Area A.

In previous sections of this book you have used aerial photographs to recognise many different features. In these photographs we can identify such functions as farms, houses, factories, shops, recreation areas, parking areas, roads and railways. Using a piece of tracing paper, indicate on the tracing where you can find an example of these functions in the photograph. Which of these functions can't you find?

Look carefully at the large building on the photograph (ref. 7C) and its surrounds. What sort of building do you think it might be? Look at figures 14.1 and 14.2 (one photograph of the building from outside, one from the inside). Do

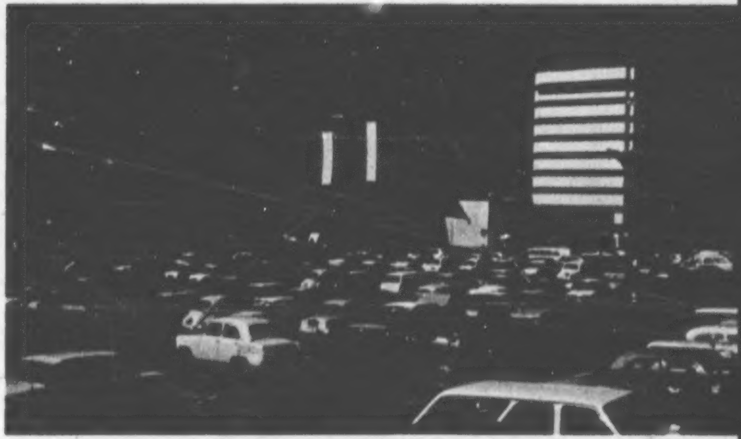
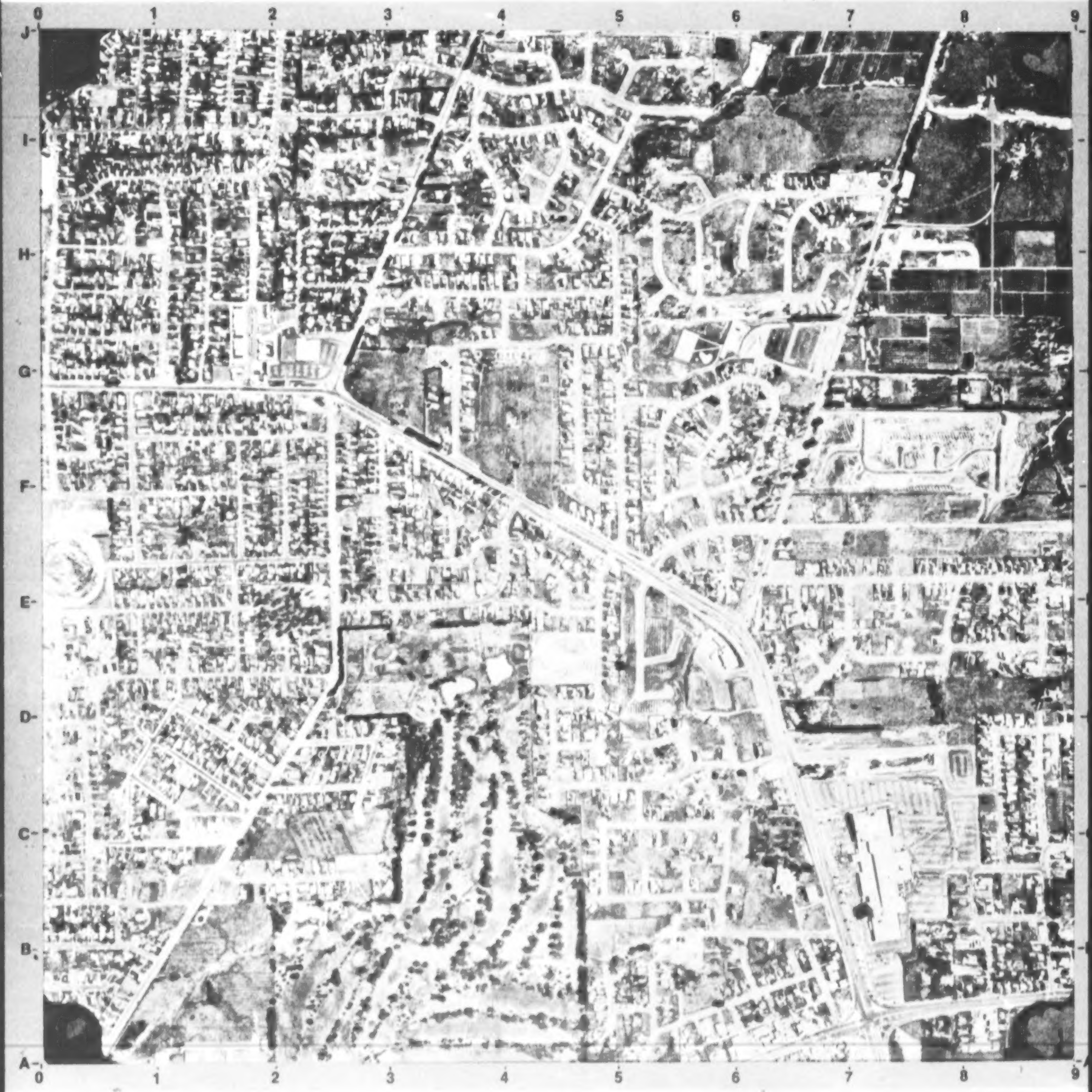


Figure 14.1

Figure 14.2

Figure 14.3



0
1
2
3
4
5
6
7
8
9
J
I
H
G
F
E
D
C
B
A
N

[illegible] 15 January 1972

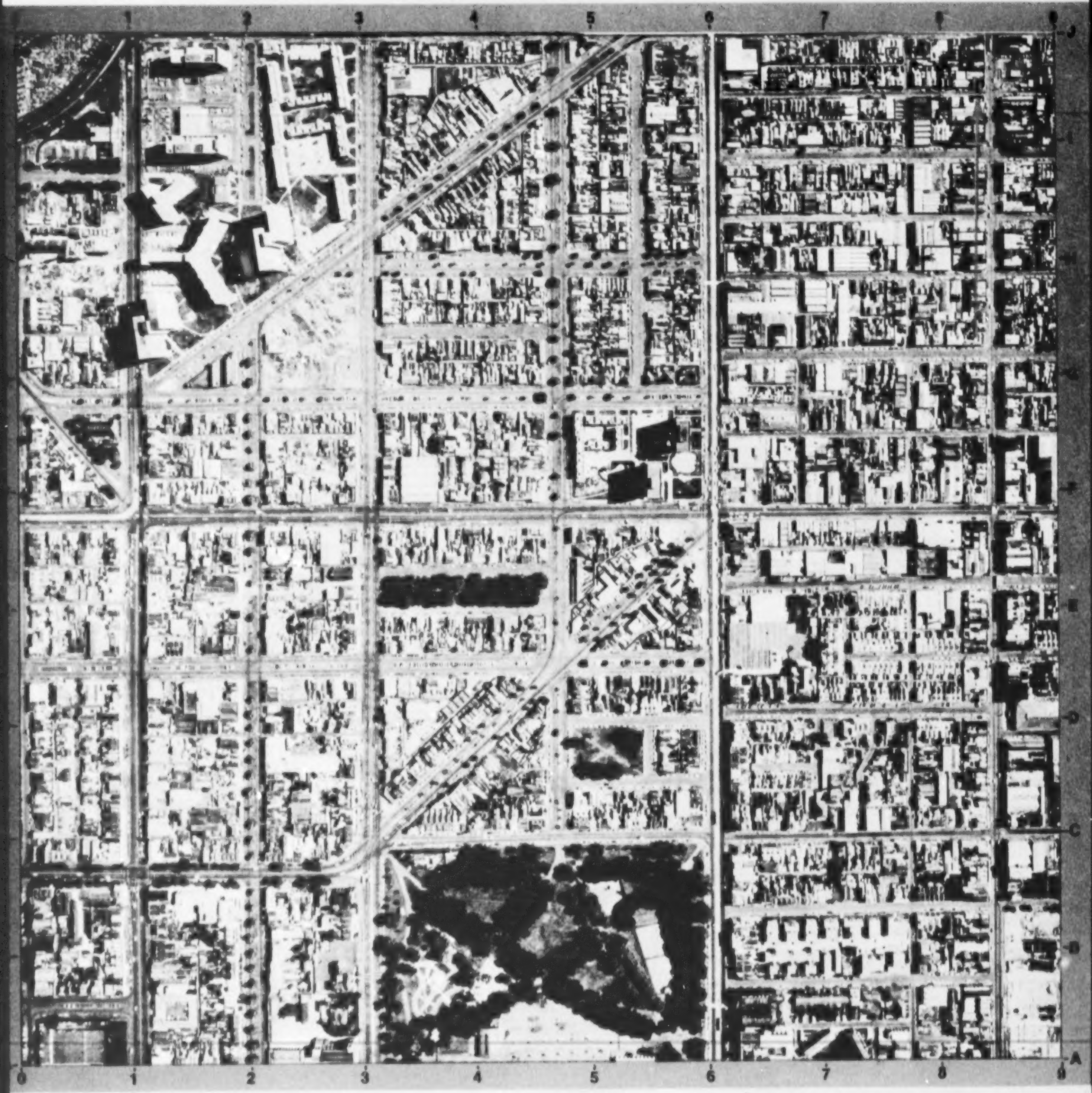

0
1
2
3
4
5
6
7
8
9
J
I
H
G
F
E
D
C
B
A

Figure 14.5 Area B—scale 55 metres to 1 centimetre (approx.), 15 January 1970

Figure 14.6

Figure 14.7

Figure 14.8

Figure 14.9

Figure 14.10

Figure 14.11

Figure 14.12

Figure 14.13

these photographs confirm or throw doubt on your idea?

On the piece of tracing paper, trace the roads within the area 4F, 4J, 7J and 7F. How would you describe the pattern? What advantages or disadvantages would this sort of road pattern have?

Now look at figure 14·5 showing Area B (note that the scale of this photograph is twice as large as that of figure 14·4).

With figure 14·4 you made a tracing showing the location of different types of buildings. Do the same with this photograph. How do the functions of this area differ from those of Area A?

Look at the large building between refs. 1H and 2H. What sort of building do you think this might be? Figure 14·3 might help you to work out your answer.

Using tracing paper, trace the roads within the area 3F, 6F, 6J and 3J. What is different about the road pattern in this area? What advantages or disadvantages do you think this road pattern would have, compared to the road pattern you saw in Area A? By this stage you should have some idea of the differences between these two areas. But we need to look more carefully.

Look at a residential area in figure 14·4 and in figure 14·5. Is there any difference that you can see in the types and sizes of the houses?

If you had walked around the two areas you would have seen the features that you can see in figures 14·6 and 14·7 (Area A) and figures 14·8-14·17 (Area B). The location of each of the photographs is shown on figures 14·18 and 14·19. Look carefully at each photograph; what would you see if you walked around these areas? Do the two areas look the same? How do they differ?

Figure 14.14

Figure 14.15

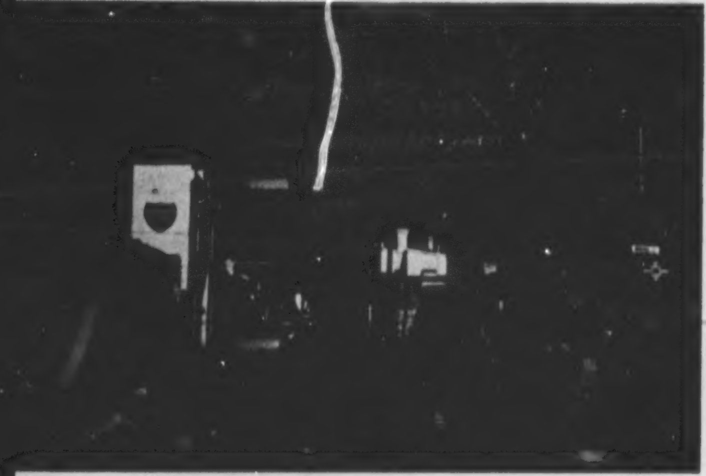


Figure 14.16

Figure 14.17

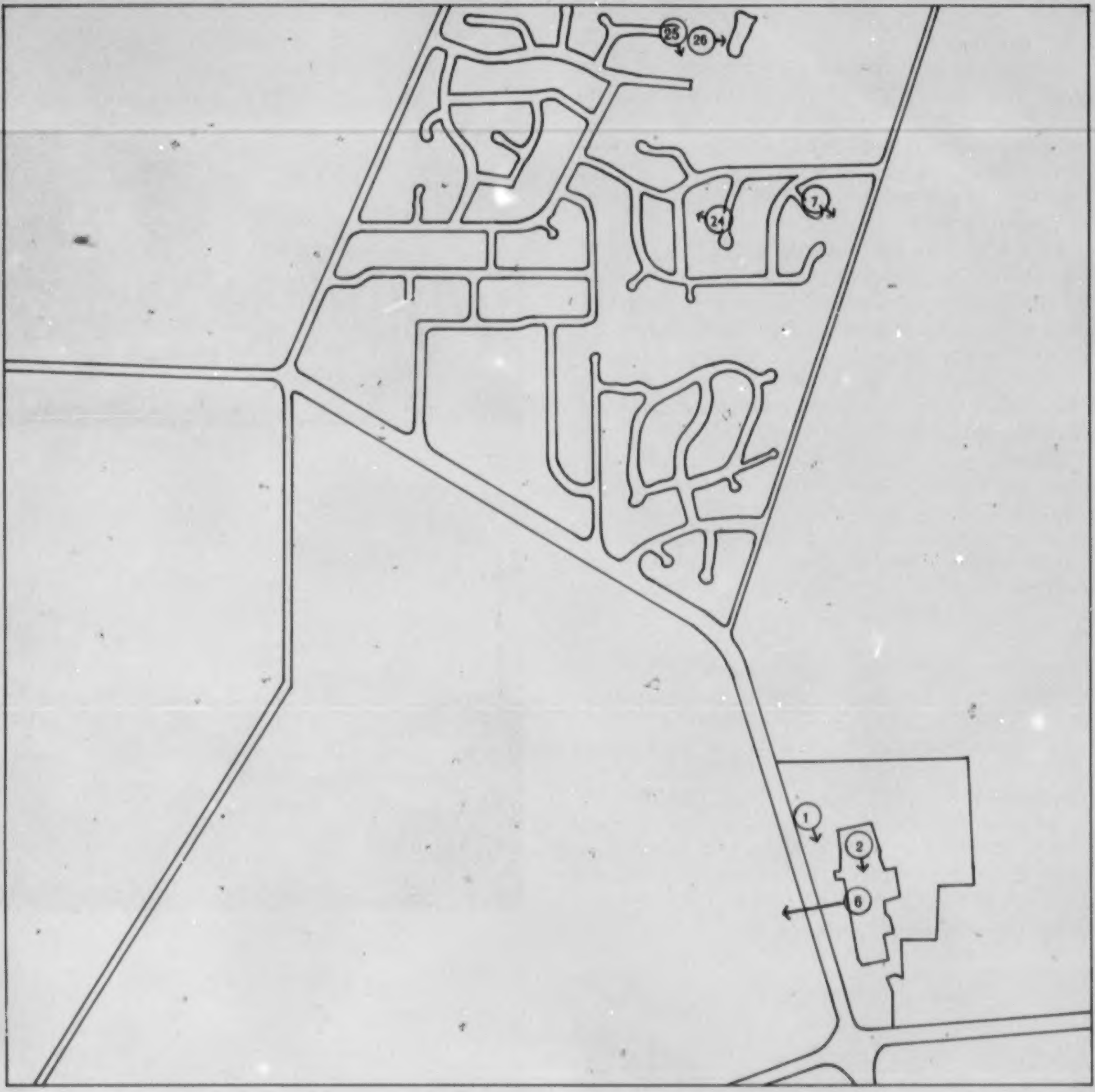


Figure 14.18: Location diagram for photographs of Area A

Section B

Just looking at photographs doesn't help us to discover what the people are like and how old they are, what they do and what their nationality is, how many factories there are and what type they are. From what you have seen so far of the two areas, what would you expect to find in each area? What you write down are your *hypotheses* or guesses. When you finish this, go on to see whether you are right. (To help you with your note making and comparing, rule up your page as shown in table 14·1 — fill in all your answers on this table.)

You are now going to examine some statistics and graphs about four suburbs, two of which are Area A and Area B. Your hypotheses will help you work out which of the areas is which suburb.

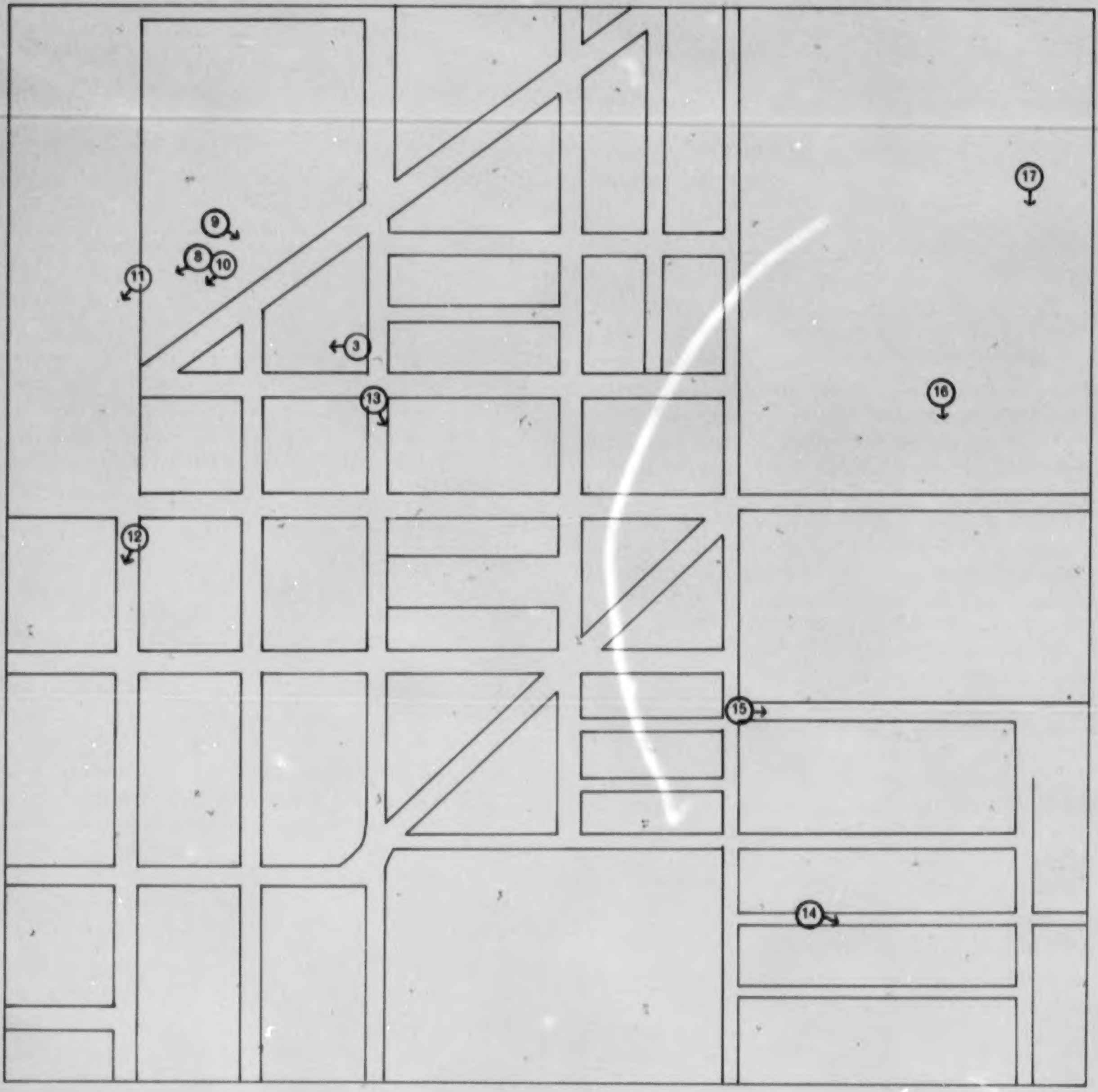


Figure 14.19: Location diagram for photographs of Area B

Table 14·1

	Suburb A	Suburb B	Suburb C	Suburb D
Population and the houses				
Age and sex of the population				
Occupations				
Factories				
Nationality				
Other notes				

Table 14·2: Area, population and dwellings

Suburb	Area (hectares)	Population			Population Density 1969 (persons/ha)	Dwellings	
		1961	1966	1969		1966	1969
A	8,945	13,940	30,087	48,400	5.4	10,179	14,656
B	365	29,399	27,227	26,600	72.9	7,484	7,545
C	9,825	26,798	43,398	49,000	4.9	11,146	13,322
D	475	25,413	22,469	21,500	45.3	6,373	6,553

Source: Commonwealth Bureau of Census and Statistics

The population and the houses

Refer to table 14·2. Which suburbs are increasing in population and which are decreasing?

Which suburb is increasing the quickest? You will need to compare the 1961 population with that in 1969.

Which suburb is decreasing quickest?

Population density is concerned with the number of people living in, for example, a hectare or a square kilometre. From what you saw in the photographs, which of these two areas should have more people living in each hectare? Do the figures agree? From your answer to that question, which suburb in the table might be of the area in figure 14·4 and which of the area in figure 14·5?

When you compare the number of dwellings (houses) in each suburb with the number of hectares of each suburb, what differences do you find between the four suburbs? In all of the four suburbs, did the number of dwellings increase from 1966 to 1969? This is unexpected in suburbs B and D. Why? Try to suggest an explanation.

Population by age and sex group

What are the ages of the people in the four suburbs and what numbers are in the two sexes? When geographers try to find out the answer to this sort of question, they draw what are called age-sex pyramids (see figure 14·20). The pyramid is divided into two halves with the females on the right and the males on the left. Across the bottom is a scale indicating percentages. Up the middle are the age groups in five-year groups: 0-4 years of age, 5-9, etc. (And so in the age-sex pyramid for suburb A, between 15 and 20 per cent of all males are in the age group of 0-4 years.)

Work out from each pyramid the percentage of males and of females under the age of 10 years. Look carefully at your results. What sorts of extra facilities would a suburb with a very high percentage of young people need? Do the suburbs with a high percentage of young children also have a high percentage of young parents? Decide what age groups the 'young parents' would be in and see whether you are right.

Which suburbs have a larger percentage of older people? What sorts of facilities would be required here?

Population by occupation

Refer to figure 14·21. What sorts of jobs (occupations) do the people have? Here the graphs show five major categories (note that both male and female percentages should be read from the base line).

For each suburb, list in order (from highest to lowest) the types of occupations. What are the major differences between the four graphs?

Look at table 14·3. Does the data here agree with your answers to the previous question?

Which suburb or suburbs are likely to have higher incomes? How might this affect the style of housing in each suburb?

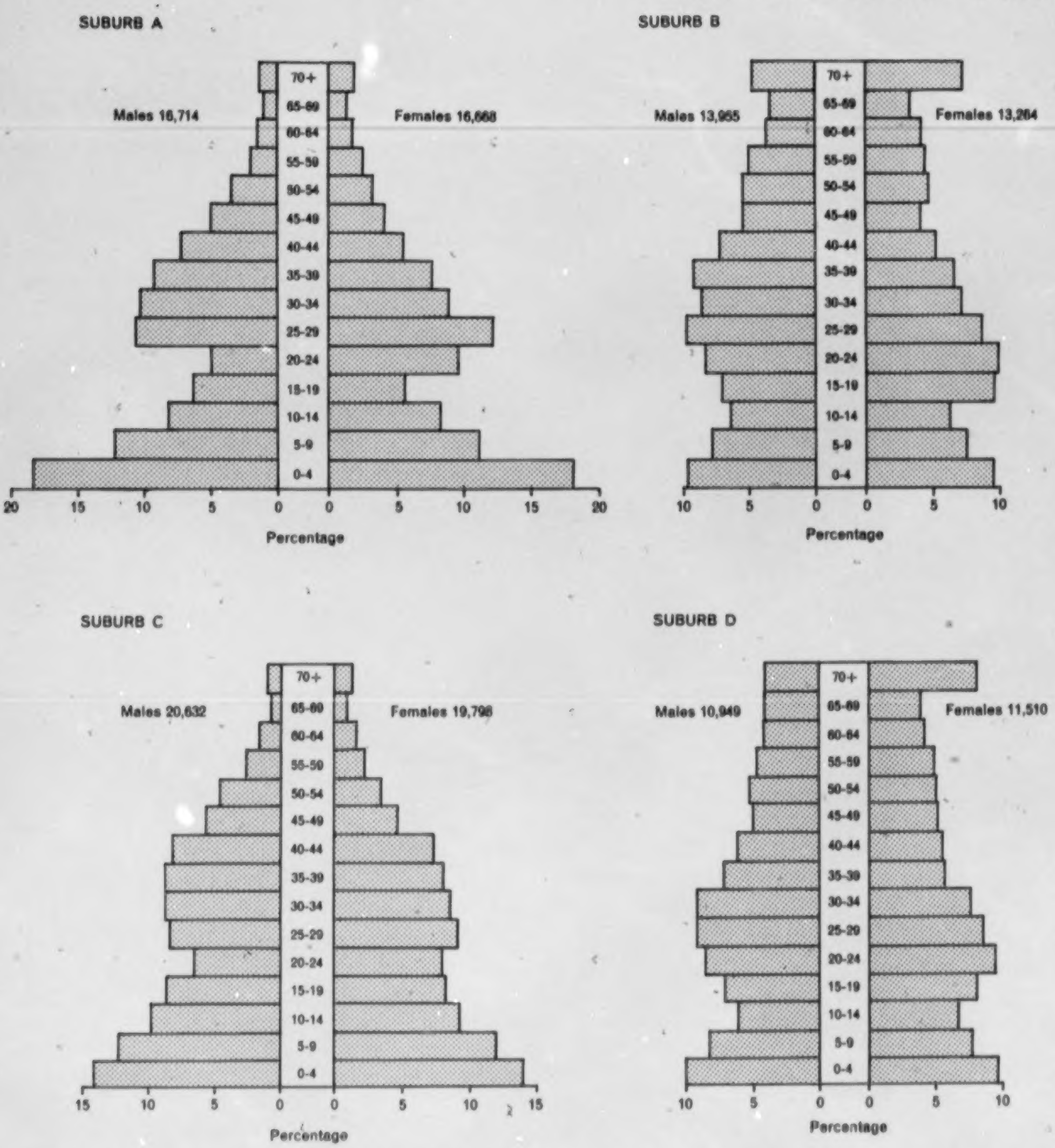
Which suburb appears to be most heavily industrialised? How might this affect the style of housing in each suburb?

Population by nationality

Refer to figure 14·22. What nationality are the people? Quite obviously most people are British (either born in the U.K., Australia and N.Z., or those who have been naturalised). But what about the proportion of non-British citizens in each suburb? Which suburb has the largest proportion of non-British people? Which non-British group appears to be most significant in each of the suburbs?

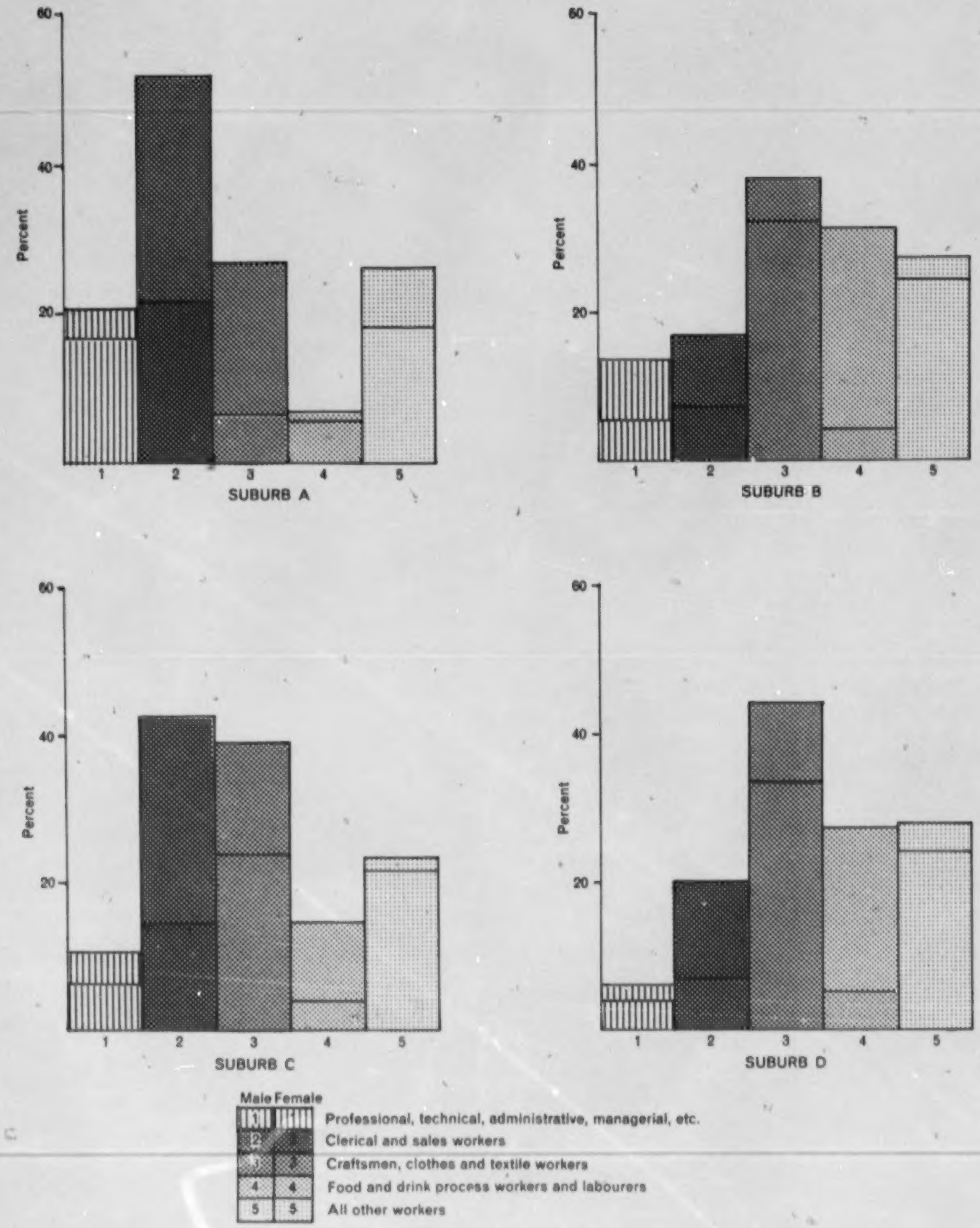
Refer back to figures 14·4 and 14·5, the information you discovered from the photographs, and look at your table (14·1). Which suburb do you think is shown in figure 14·4 and which in figure 14·5? Why?

You should now have the answer to our question: 'Are all urban areas the same?' What do you think?



Source: Commonwealth Bureau of Census and Statistics

Figure 14.20: Population by sex and age group, 1966



Source: Commonwealth Bureau of Census and Statistics

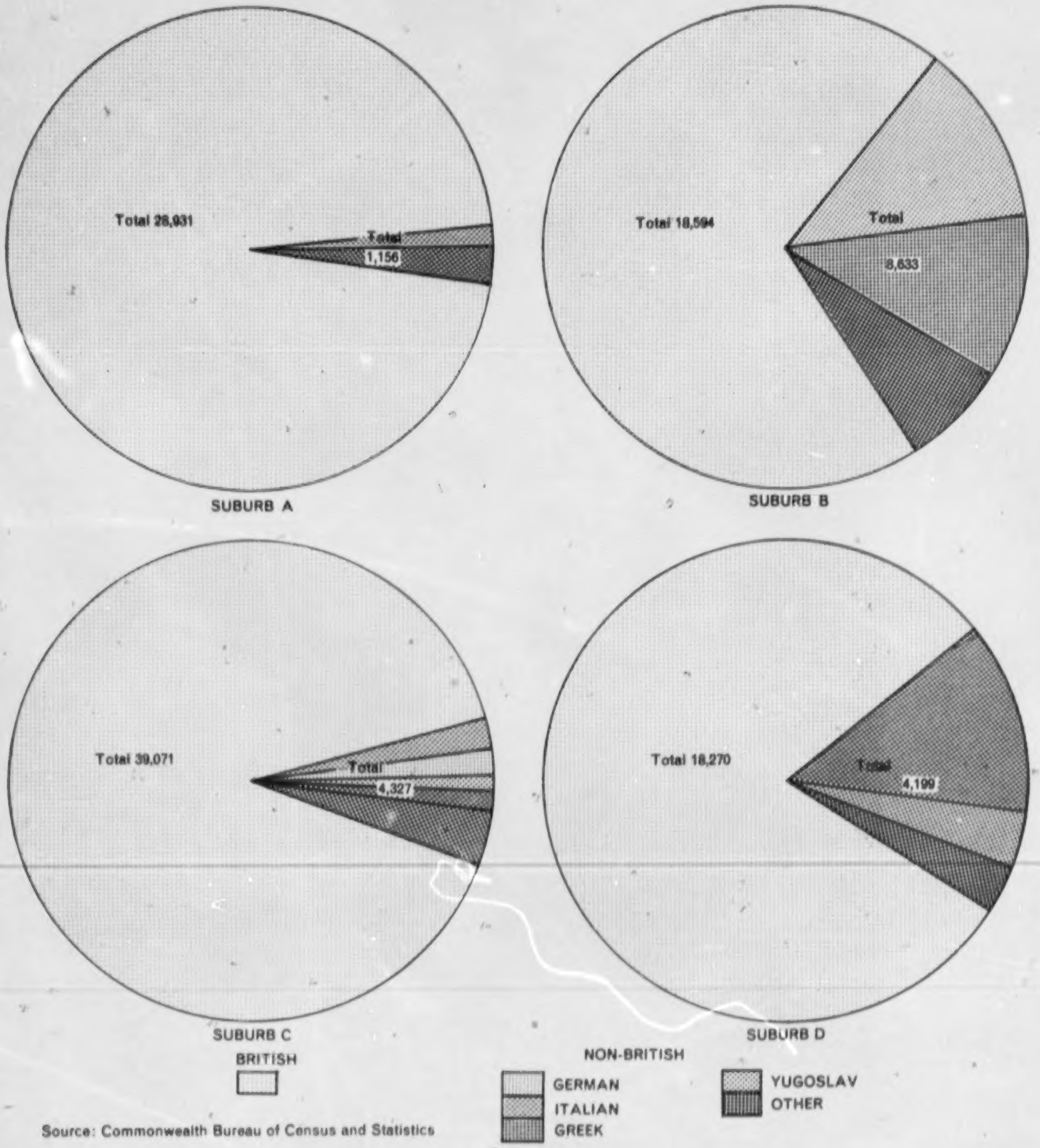
Figure 14.21: Population by occupation, 1966

Table 14.3: Factory statistics, 1967-8

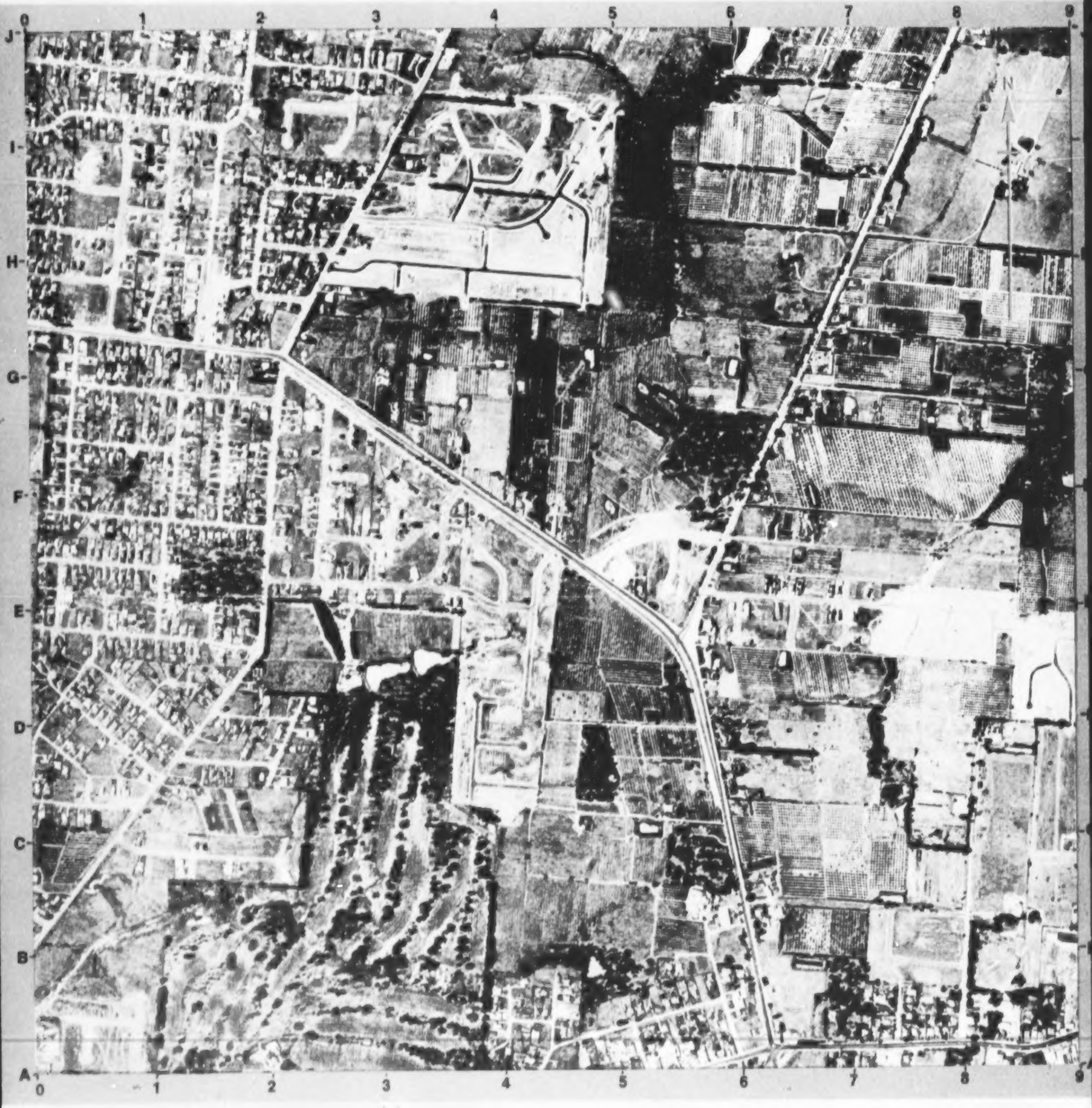
Suburb	% of Land Zoned for Industry	Number of Factories	Persons Employed		Salary and Wages Paid $'000	Production $'000	Value of Land, Buildings, Plant and Machinery $'000
			Males	Females			
A	0.3	82	590	137	1,841	3,853	5,267
B	13	418	5,983	5,648	28,041	45,960	40,119
C	3	144	5,231	806	20,934	34,854	21,107
D	27	574	10,663	8,170	48,351	92,416	81,495

Source: Commonwealth Bureau of Census and Statistics

Figure 14.22: Population by nationality, 1966



Source: Commonwealth Bureau of Census and Statistics


0
1
2
3
4
5
6
7
8
9
J
I
H
G
F
E
D
C
B
A
N

[illegible] Area [illegible] December 1965

Section C: Do urban neighbourhoods change?

Area A

Look at figure 14·23. This is a photograph of the same area as figure 14·4, but taken five years previously. Look also at figures 14·24-14·26.

What changes have and are taking place?

Why do you think these changes are occurring?

Area B

Look at figure 14·27. This is a photograph of the same area as figure 14·5, but taken ten years previously. What changes have taken place? Why do you think that these changes have occurred? In what ways do the changes in Area B differ from those in Area A?

What answer do you now have to our question? What further developments do you think will take place in these areas? What would be the advantages or disadvantages of living in either area?

Section D

You have discovered a number of features about four urban areas around Melbourne. Are their characteristics restricted to their particular area or to Melbourne? Look at your home area. Is it like those you have studied, or is it different?

Key to colour photographs

Here are some details that you may find interesting regarding the previously unidentified photographs.

Lower Templestowe (Area A)

14·1: External view of Doncaster Shoppingtown — the development of a modern shopping complex with emphasis on parking space and shopper convenience

14·2: Internal view of Doncaster Shoppingtown

14·6: View from Doncaster Shoppingtown looking across the golf links to the west — note the profile of the CBD

14·7: Residential development of the area

Figures 14·24, 14·25 and 14·26 emphasise change and were taken in 1971. Comparison with figure 14·4 is useful.

14·24: Rapid growth of housing — note features of the area which make it desirable as a residential suburb

14·25: Further evidence of residential development — note Doncaster Shoppingtown tower in the background

14·26: The orchard and dam, Ref. J6-J7 on figure 14·4, prior to subdivision for housing estate development. The apple trees have been bulldozed and the dam drained.

Figure 14.24

Figure 14.25

Figure 14.26

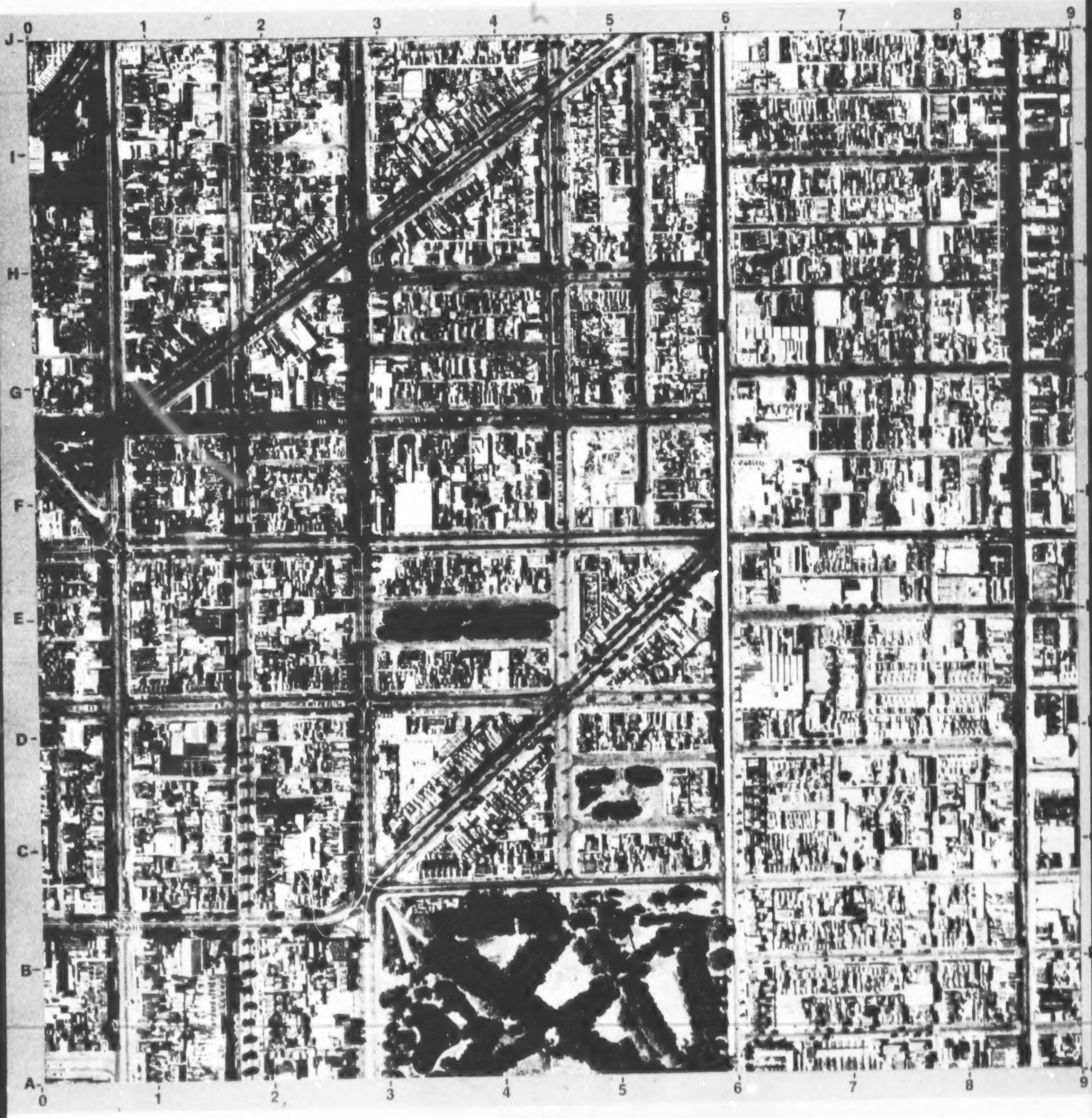

0
1
2
3
4
5
6
7
8
9
J
I
H
G
F
E
D
C
B
A

Figure 13.21 Area B — scale 55 metres to 1 centimetre (approx.), 30 January 1960

Carlton and Fitzroy (Area B)

14·3: View towards the Carlton Estate — undeveloped land in foreground
14·8, 14·9, 14·10: Views from upper storey of Carlton Estate building — note Atherton Street Estate, Fitzroy, in background of figure 14·9 (figure 14·5, Ref. A9)
14·11: Older residential buildings opposite the Carlton Estate
14·12: Shopping area, Carlton
14·13: Residential street
14·14: Modern flats — private development
14·15: Residential street
14·16: One of the smaller streets — industrial area
14·17: Shopping area — note influence of migrants

HOW TO DO YOUR OWN FIELDWORK

You will have realised by now that geographers are people who are very interested in the world in which we live. You will have realised, too, that in order to carry out their task of understanding how man interacts with his environment a very great deal of first-hand observation is required. Geographers are concerned with a 'real world' and the only way to gain maximum knowledge and understanding of that world is to go and look for oneself. Not all the maps, photographs and statistics we can gather will completely take the place of real-life observation. Fieldwork, then, is the means by which geographers collect the information they require, and all of the studies in this book are based on such field studies. However, by this time you should be interested in doing some fieldwork too — in collecting information about your area or other areas nearby and far away. How can this fieldwork best be done?

What to study

The first thing to decide, either as an individual or as a whole class, is the coverage of the survey. Do you want to survey land use in your local area? Do you want to survey land use in a farming area at some distance? Do you want to study the soils, vegetation and climate of your local area? Do you want to study traffic flows or measure the size of the trade areas of a number of different shopkeepers in your area? Do you want to find out where the people in your area work? Do you want to survey the age of the houses in your area? Do you want to survey a local factory and find out why it is located where it is, what it does, and what raw materials it uses, etc.? All of these things are possible, and indeed may be very valuable forms of fieldwork for you to undertake.

We would suggest that you do fieldwork in your local area which will allow you to compare your area with those studied in this book. We have not given details here of the best way of tackling *all* the above-mentioned types of field study, but we have concentrated on the study of land use and of trade areas. Your teachers will of course help and advise you at all stages, but fieldwork should be basically the work of the students, and the results may indeed be of interest and value to other people in your school and to your local community. Perhaps in later years you will be able to undertake field studies designed to provide needed information to your local council on the benefits or losses associated with new road projects or shopping centre developments. However, at this stage it is most important that you decide what you would like to survey and then plan it most carefully. If your planning is thorough, then your survey will almost certainly be successful.

Planning a land use survey in the local area

The first decision that will confront you is 'What area shall we survey?' Two points are important in reaching your decision:

- How much time do you have for the survey?
- Which areas interest you most?

It is desirable to select an area that you find interesting, and at the same time to select an area that can be readily reached from school so that you will be able to complete the survey in a reasonable length of time (for example, 3 or 4 class periods).

Land use surveys require base maps that you can write on and colour according to the particular land use type. These maps can be made by tracing from aerial photographs or from large-scale (1 cm to 5 metres, or 1 cm to 10 metres) maps (figure A). Each student (or group of students) should have a base map for the area for which he is responsible. Preferably, each separate block of land (allotment) should be marked on it. No student or group should be asked to survey too large an area in the time allowed — this will only lead to haste and error and a poor final result.

You must then decide on the various categories of land use you are going to record. Clearly, if a shopping centre is included in the area to be surveyed you will not want to record each shop as a separate item on the map — you may decide to call *all* shops *commercial*. Similarly, you may decide to call all factories *industrial*, and all houses *residential*. The classification you decide upon must be clearly understood by all members of the class before you commence the survey. At this stage you would be best advised to select a small number of broad categories for the task.

You should then discuss the method to be used in recording the information, and what to do in the case of a form of land use which doesn't seem to fit the categories selected earlier. Often the best method of recording is to allocate to each category a certain colour and simply colour each allotment on the base map in the appropriate colour. Ideally, each student or group should use the same type of coloured pencils so that there is no confusion when the base maps are put together after the survey is completed (figure B).

Your teachers will arrange the times for the carrying out of the survey and you will then proceed along the lines already decided.

When you return

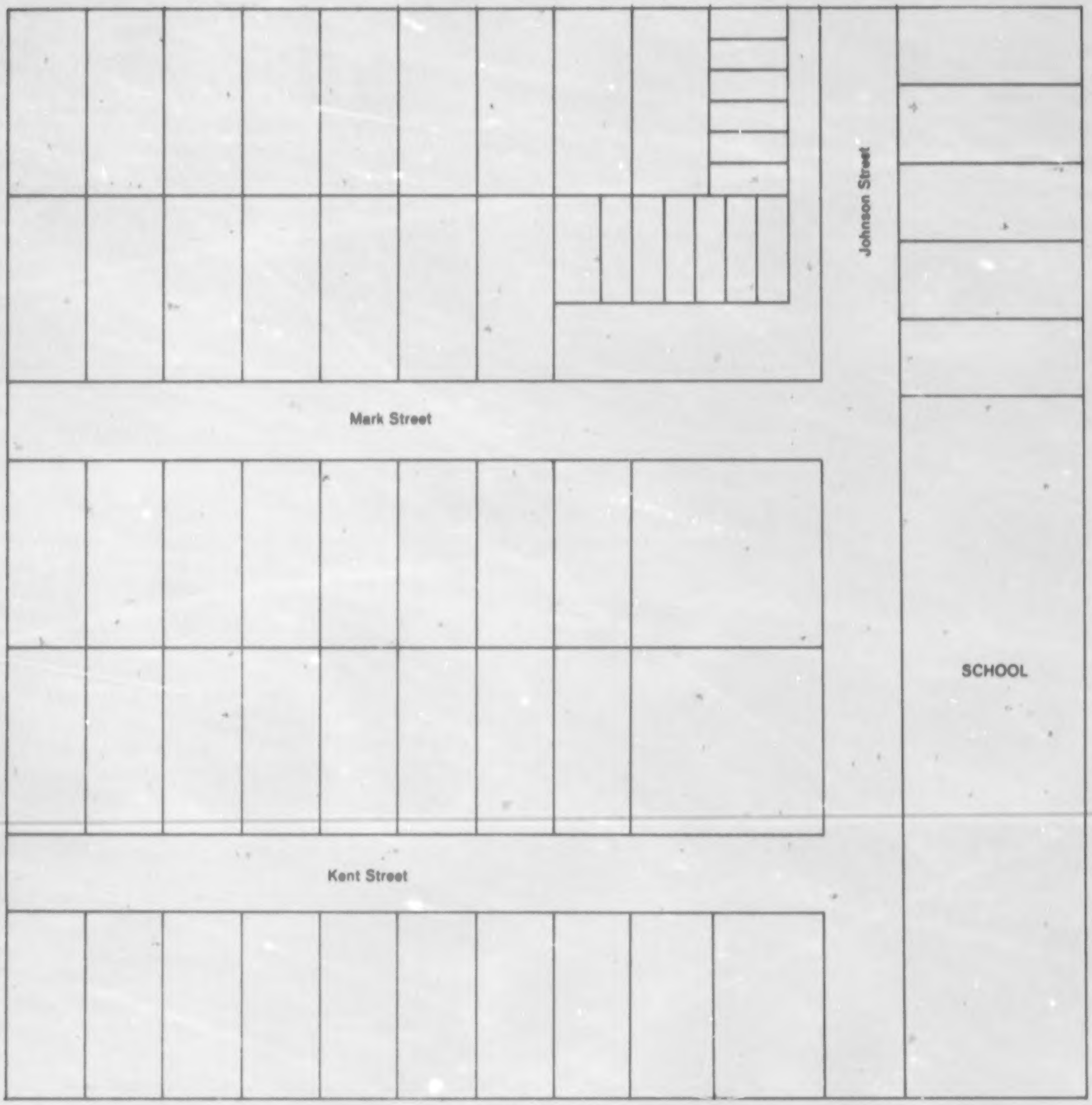
The actual task of surveying an area is of course only the very first stage in the geographer's programme. The hard work is still to come.

You must discuss any land uses that did not seem to fit the categories and decide what to do with them.

Base maps must be completed carefully and then fitted together to form a complete *land use map of the local area.*

Now you must study the data you have obtained. There are many things you can do, for example:

- Describe the land uses in the area.
- Describe the distribution of each type of land use.



Scale: 1 cm to 10 metres

Figure A

- Compare the location of each type of land use with the distribution of roads, railway lines, steep slopes, areas subject to flooding, etc., and with the distribution of other land use types.
- Consider whether some of the relationships you have discovered are cause-and-effect relationships.
- Write a final report on the survey data, comparing your area with one studied in this book and perhaps with areas studied by other

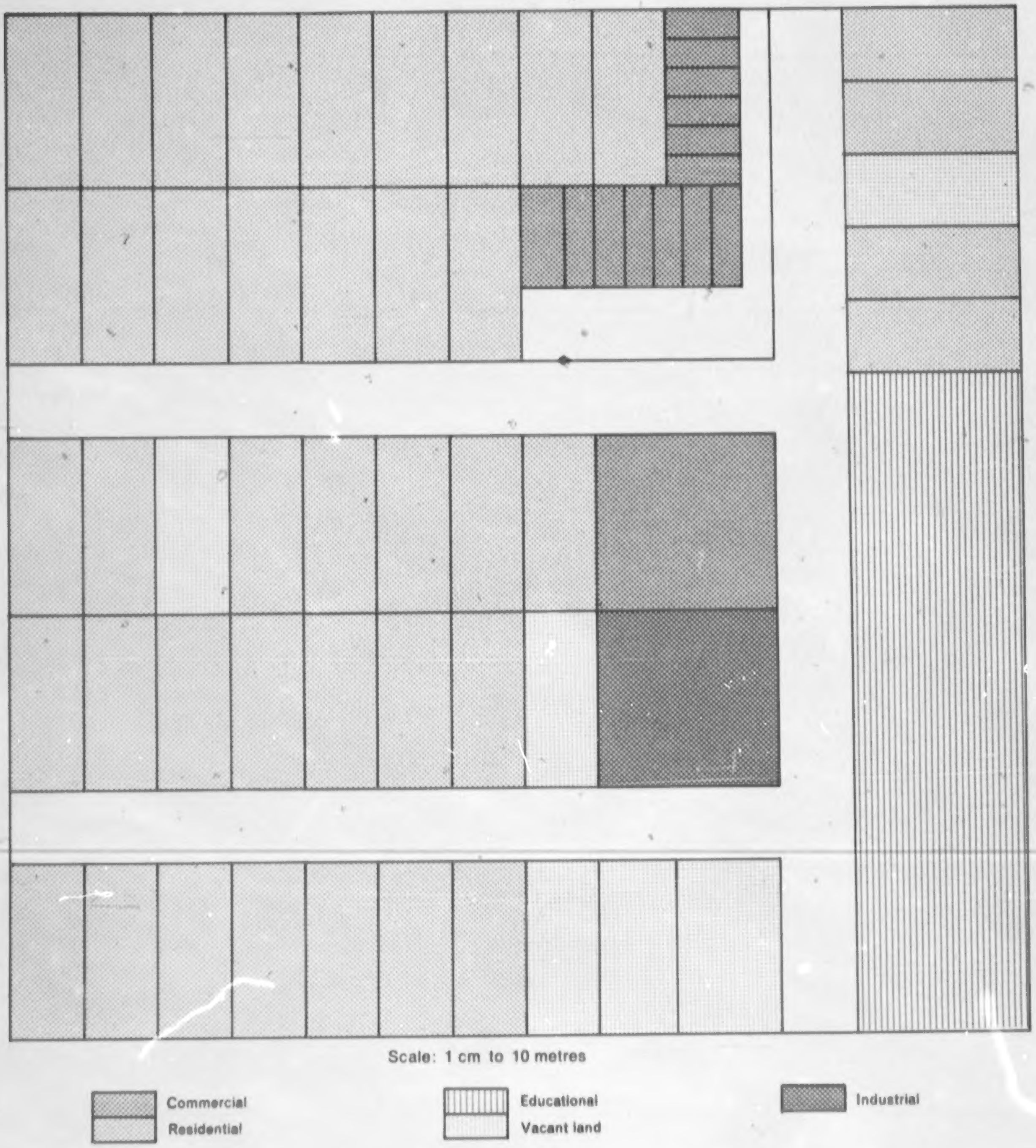

Scale: 1 cm to 10 metres
Commercial
Residential
Educational
Vacant land
Industrial

Figure B

schools. You might like to write to another school on the other side of town or in a completely different area, and arrange to give them a map of your area with all the survey data on it in exchange for one of their area.

A survey of trade areas

In this case you will be particularly interested in finding out the maximum area within which customers regularly come to shop at specific stores.

You might decide to study the trade areas of the chemist, the grocer, the newspaper shop, and the schools.

If you live in the country, you will probably require a map showing distances of up to 40 or 50 km. If you live in the city, then distances of up to 10 km should be sufficient.

The class can be divided into four groups, each responsible for one of the functions selected for study.

The groups will then visit all businesses concerned with their selected function in their local area or town to ask from how far in each direction *regular* business comes.

When the interviews are completed, a line is drawn around the outermost extent of the group's business 'pool'. The line drawn by each group is placed on a master map, which will finally have on it lines representing the maximum trade areas for each function selected for study (figure C).

Students can then complete their own maps from the master map, and discuss the reasons for variations and the value of drawing an 'average' line to define the hinterland of the town.

The schoolground as a site for fieldwork

All of the suggestions made so far refer to fieldwork in the area outside the schoolground, but a great deal of important work can be done within the school boundary itself, for example:

- Fieldwork designed to develop map-making and map-reading skills using simple maps of the schoolground and buildings, and also involving use of the magnetic compass.
- Fieldwork designed to relate a contour map of the schoolground to actual areas. Exercises in measuring slope and differences in height.

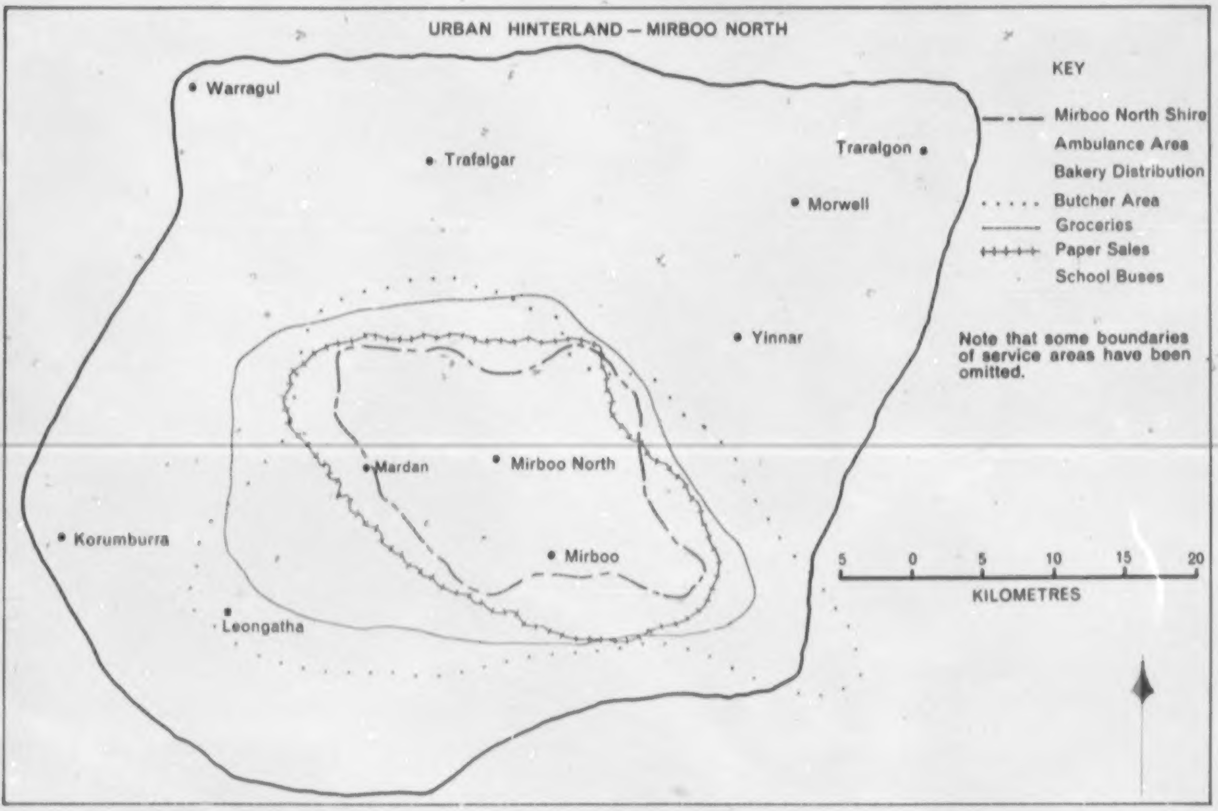

URBAN HINTERLAND — MIRBOO NORTH
Warragul
Trafalgar
Traralgon
Morwell
Yinnar
Mardan
Mirboo North
Mirboo
Korumburra
Leongatha
KEY
Mirboo North Shire
Ambulance Area
Bakery Distribution
Butcher Area
Groceries
Paper Sales
School Buses
Note that some boundaries of service areas have been omitted.
5
0
5
10
15
20
KILOMETRES

Figure C

- Field exercises involving the observation and recording of weather and climatic data:
  - cloud cover
  - cloud types
  - fronts
  - wind speed and direction
  - influence of aspect on temperature, rainfall, frost, etc.
  - rainfall
  - temperature
  - humidity.
- Studies of vegetation and soils using very simple classifications.
- Studies of traffic flows around the school, e.g. movement of students at recess times both inside the school buildings and outside in the schoolground.

MY IDEAL TOWN

Why do you live where you do? What are the advantages of living in your town? What are the disadvantages?

If you were able to build a town with all the advantages you desire, what would you want your town to be like? Where would you put it? Where would you place things within the town itself?

You may like to undertake a study to design your ideal town. Try to decide where you would build it within Australia. The following steps may assist you in making the decision:

1. *Decide on the state in which you will build your ideal town.* You may find films, maps, photographs and statistics of value to you. If the whole class, many groups or simply one group is involved in the project, you will need to listen to the views of other students. They may have good arguments for building the town in a state different from the one you have chosen. A series of secret ballots may be held until only one state remains.

2. *Decide the area of the state in which you will build your ideal town.* This step may involve you in another period of research. This time, your research may be more detailed. The participants in the project may divide the state into a number of areas to enable a vote to be taken to decide which area is to be used for the ideal town.

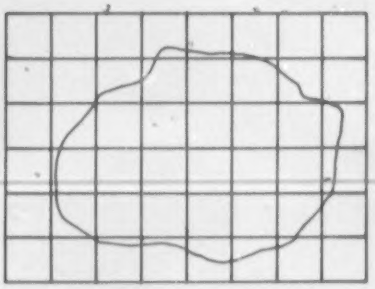
3. *Decide the exact site for the town.* Making this decision will involve more research and the use of photographs and topographic maps. What things would you look for to decide the site for a town? After a period of research, another series of secret ballots may be held until there is only one site left. If there is a town already on the particular site, you may imagine the site as if the town was not there. On the other hand, your class may wish to rule out any site which is already occupied by a town.

4. Pool all the reasons in favour of the site selected.

5. *Decide on a name for the town.*

6. *Decide on the ideal population of the town.* This may involve more research and more debate.

7. *List all the buildings which your town will require.* You could assume that there will be 4 people per house for most houses. What other



Enlarging a simple shape by the grid method

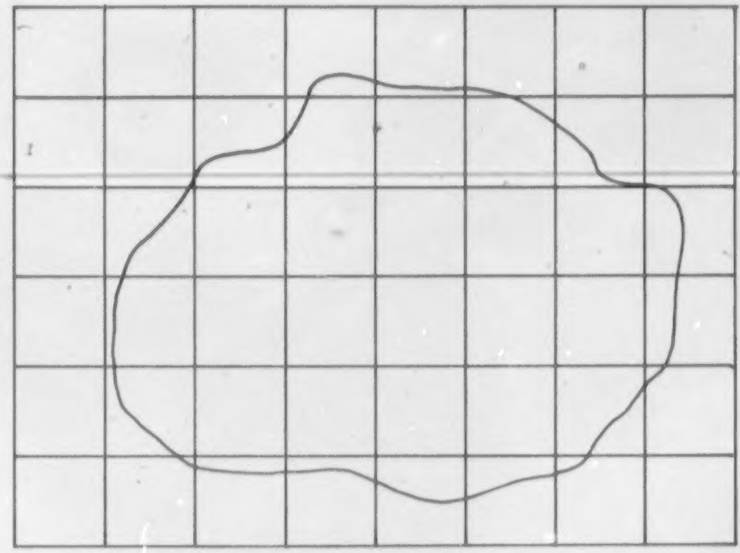


Figure D

buildings will you require? What allowances will you make for tourists and visitors? What goods and services could be provided by a town of the size you have chosen?

8. *What other land uses would you like in the town?* For example, do you want recreation areas?

9. Make sufficient copies of the town site, at a scale of about 1 cm to 25 metres, for each participant in the project to have a copy. Using a lead pencil, sketch out a town plan. The various proposed plans should be discussed and agreement on a single town plan should be reached.

10. *Enlarge the town plan to a scale of 1 cm to 5 metres.* Your town plan will now probably occupy a table top. Your teacher may help you to make the larger map by using the grid method, as shown in figure D.

11. Build model houses, shops, factories, etc. according to the list drawn up as step 7. You may use any material you can think of — cardboard, paper, plastic, pins, stones, boards, nails, pins, tapes, plasticine, clay, model cars, etc. When each building is completed place it on the map space allocated to it.

12. Check the model. Where are the roads? the highways? residential areas? business areas? the schools? the hospital? parks? rubbish dump or waste disposal areas?

Throughout the project, you could keep a notice board outlining the progress made. Your class may like to organise into groups to do special tasks, e.g. map drawers, model house builders, data collectors, and so forth. You may also like to interview town planners, city or shire engineers, estate agents and other people concerned with town plans. When you have finished the project, you might like to ask other classes, your parents and the general public to see it.

15

Evaluation

During the studies in this project you have been asked to do a number of things which perhaps you have not done previously.

One thing you should be able to do is to read a topographic map. Questions 1-4 will test whether you can.

1. Refer to the map of Young 1 : 50,000 (figure 15·1), on page 150.

(a) What features are located at

G.R. 310657?
G.R. 311554?
G.R. 326623?
G.R. 365592?

This will test whether you can use a grid reference.

(b) If you caught a train at Young and travelled to Maimuru in the north-west, how far would you travel? If you drove a car from Maimuru back to the railway station at Young, would it be further or shorter than by train?

(c) Look at the railway line and follow it from Young as it travels north. Why do you think the people who built the railway made such a big loop, instead of laying the track straight to where they wanted to go?

2. Refer to the map of Canberra 1 : 50,000 (figure 15·2), on page 151.

(a) The contour lines indicate how high places are above sea level, but they also indicate how steeply the land slopes.

(i) What is the height of the highest point on this map?

(ii) There are two or three mountains shown on the map. What are their names and which seems to have the steepest slope?

(iii) Calculate the gradient of the steepest slope. Could a car drive straight up this slope?

(b) During the activities in this project, you have looked at a number of photographs and maps showing roads and housing areas.

(i) What is the difference in the pattern of roads between the suburbs of Chifley, Lyons and Curtin to the south-west of the map and the suburbs of Braddon and Turner just north of Lake Burley Griffin? From the studies in the project, name a place which has a similar pattern to Chifley and one which has a similar pattern to Braddon.

(ii) Geographers are always trying to explain why something is in a certain place, as you have seen. Look at the arrangement of housing areas in Canberra. What can you suggest that might help to explain the distribution of housing areas? A geographer would say that there appears to be a relationship between the housing areas and ....

(c) Canberra is composed of two sections, the northern part and the southern part, divided by Lake Burley Griffin. This lake has been artificially made. How would this create difficulties for traffic planners, and how would it affect the flow of traffic?

3. Refer to the map of Shepparton 1 : 250,000 (figure 15·7), on page 154. So far you have tested yourself on whether you can use grid references, measure distances, recognise contour lines, see patterns of roads, and work out relationships.

(a) This map has a scale of 1 : 250,000. Do we say that this is a larger or smaller scale than the Canberra map?

(b) If we altered the scale of the map to 1 : 50,000, would it be able to show more detail or less detail?

(c) Figure 15·3 is a transect from G.R. 310460 drawn north along easting 310 to northing 520.

(i) On the transect, mark the location of Waranga Reservoir, and the point at which the two railway lines cross the transect.

(ii) What is different about the pattern of roads south of Waranga Reservoir, compared to north? What does the transect suggest as to why this difference exists?

(d) Compare figures 15·1 and 15·7.

(i) Is there any similarity between some of the land uses shown on the two maps?

(ii) If each black square on the two maps indicates a farm house, which area on the

Shepparton map and which area on the Young map has more farms than elsewhere? Why do you think these areas have more farms?

(e) In figure 15·7 you can see that there is one large town or city in the area — Shepparton — and a number of medium-sized towns — Nagambie, Rushworth, Stanhope, Tatura, Mooroopna, Kyabram. There are also many very small towns. Towns provide services, such as different types of shops, and other facilities. How would the very small towns differ from the larger towns in this regard? If you look at the map, and use the legend provided in the appendix, you will find something there to help you with your answer.

4. Look at all three maps — Young, Canberra and Shepparton. In each area, one city is by far the most important. If you were able to map the movement of people in each area as they travelled by car, what influence do you think each city would have on the movement? What pattern would you expect to see?

5. Another unusual diagram is a climatic graph. These questions will test whether you can read climatic graphs. Figures 15·4 and 15·5 are climatic graphs for Shepparton and Melbourne. They show details of the monthly average rainfall and temperature.

(a) Which place is hotter in summer?

(b) Which place has less rainfall in summer?

(c) Which place is colder in winter?

(d) Which place has less rainfall in winter?

(e) What would you say is the difference in climate between Melbourne and Shepparton?

6. One special picture, which looks like a map, is the vertical aerial photograph. If you can use this type of photograph, you should be able to answer these questions. Look at figure 15·6.

(a) If you are trying to find out about an area, what can this type of photograph tell you that a topographic map can't?

(b) Write a description of this area, based on the photograph.

(c) The photograph shows an outer area of Melbourne. In the course of this project you studied a similar area. What changes or developments appear to be taking place?

(d) Do you think people searching for places to build their houses are like locusts searching for food? Why? Should people be allowed to build factories or shops wherever they want to?

7. You have already used topographic maps, but there are other types of maps — figures 15·8 and 15·9 are two.

(a) Look at figure 15·8. It shows types of land use.

(i) Describe the pattern of land use. Do you find any types of land use in any special areas? Try to explain why this pattern exists.

(ii) Does the map give any indication of relief?

(iii) What other information do you think ought to be included to enable you to understand the land use better?

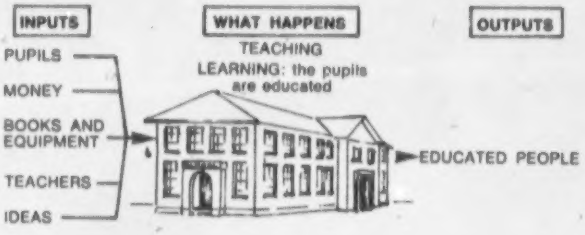
(b) Figure 15·9 shows the location of milk bars and service stations in a suburban area.

(i) There is only one doctor's surgery in this area. Count the number of milk bars. Why do you think there are more milk bars?

(ii) If you look carefully, you will find that the milk bars have particular locations. Why do you think they are in these places?

(iii) Try to explain why service stations are generally located on main roads and at major intersections.

8. During this project you have often come across the word *system*. A school is a system: it has a number of *inputs*, one major *output*, and something happens in between.



You have by now lopked at a number of systems:

- systems where man is unimportant
- farming systems
- mining systems
- industrial systems
- neighbourhood or urban systems.

Take one example of each type, and try to make a diagram like the one above to illustrate each system.

Although we hope that you have learned *how* to do some things — read topographic and other maps, use photographs, etc. — we also hope that you have learnt something from these sources. Try the following questions to test yourself.

9. 'People have no need to worry about the Barrier Reef. It has been there a long time, and anyway, nature is quite able to look after itself.' Do you agree? Why or why not? Do you think man should be free to do as he pleases on the reef? Give reasons for your answer.

10. (a) In Australia, land is a major resource which man can use to produce things. Give some

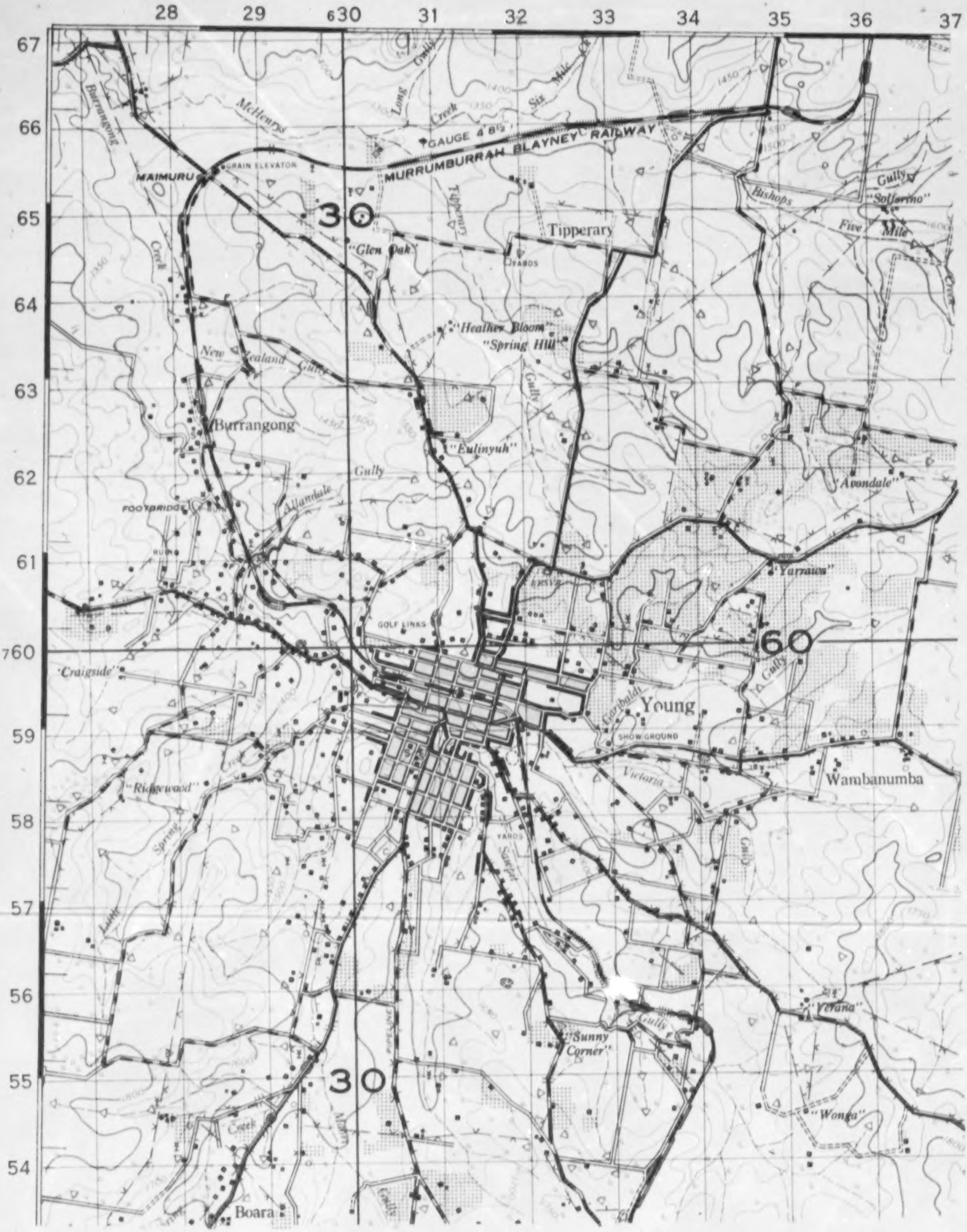
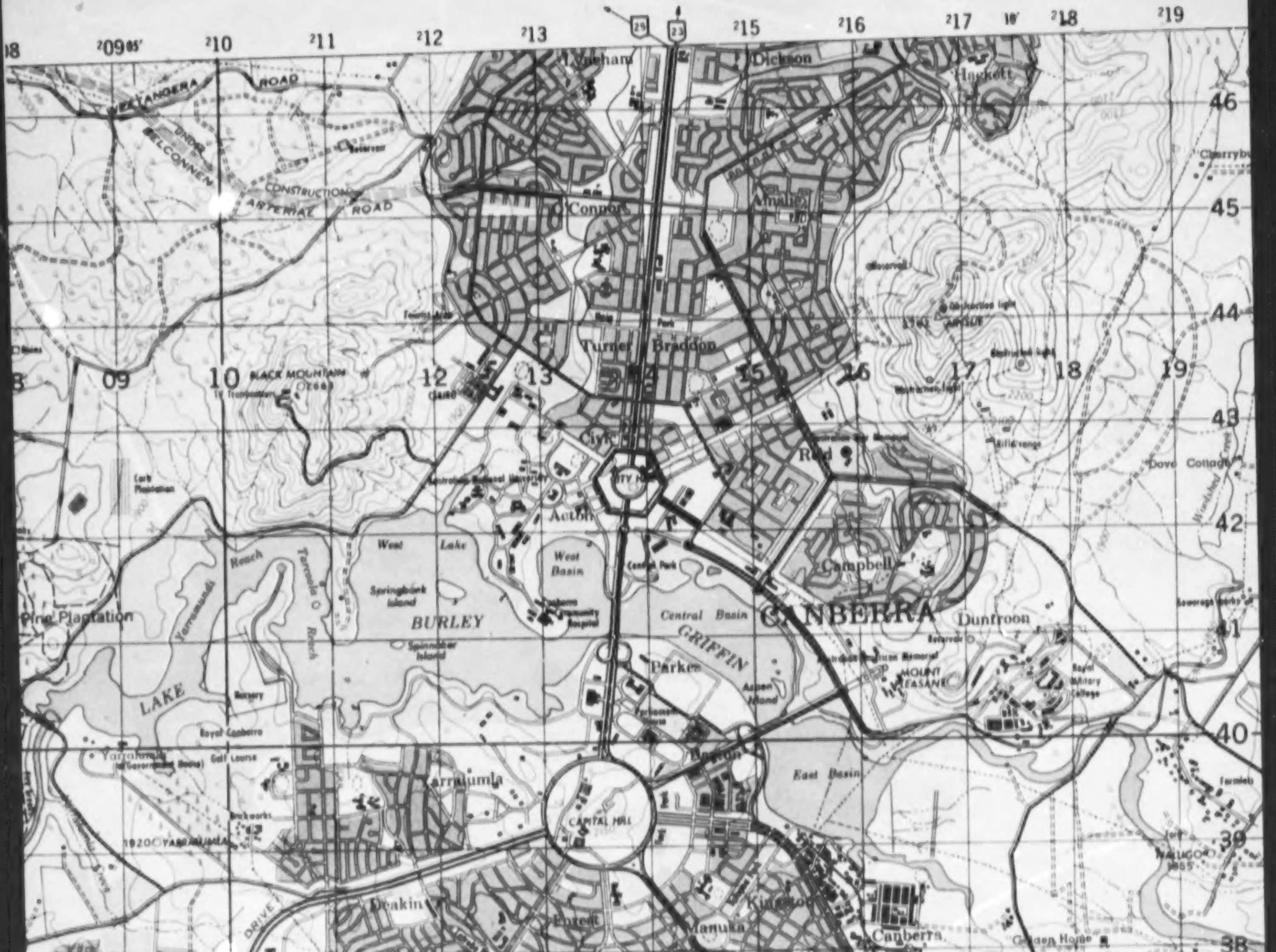

28
29
630
31
32
33
34
35
36
37
67
66
65
64
63
62
61
760
59
58
57
56
55
54
30
60
30
MURRUMBURRAH BLAYNEY RAILWAY
GAUGE 4 8½
MAIMURU
GRAIN ELEVATOR
Burrangong
Creek
McHenrys
Long
Gully
Creek
Six
Mile
Tipperary
"Glen Oak"
YARDS
Bishops
Gully
"Solferino"
Five
Mile
Creek
"Heather Bloom"
"Spring Hill"
New
Zealand
Gully
Burrangong
"Eulinyah"
Gully
Allandale
FOOTBRIDGE
RUINS
"Avondale"
"Yarraun"
GOLF LINKS
'Craigside'
Young
Garibaldi
SHOW GROUND
Gully
Wambanumba
"Ridgewood"
Spring
Creek
Victoria
YARDS
Sawpit
Gully
"Verana"
"Sunny
Corner"
Gully
"Wonga"
Creek
Moon
Gully
Boara
1400
1450
1350
1500
1550
1600
1650
1700
1750
1800

Figure 15.1: Young 1:50,000, contour interval 50 feet (Directorate of Military Survey, Canberra)



Lyneham
Dickson
Hackett
Cherrybrook
WEETANGERA ROAD
BELCONNEN ARTERIAL ROAD
UNDER CONSTRUCTION
O'Connor
Ainslie
Turner
Braddon
BLACK MOUNTAIN
Civic
CITY HILL
Reid
Acton
West Lake
West Basin
Springbank Island
Spinnaker Island
BURLEY
LAKE
GRIFFIN
Central Basin
Campbell
CANBERRA
Duntroon
MOUNT PLEASANT
Royal Military College
Dove Cottage
Pine Plantation
Yarramundi Reach
Tarcoola Reach
Yarralumla
Royal Canberra Golf Course
Parkes
Barton
East Basin
CAPITAL HILL
Deakin
Forrest
Manuka
Kingston
Canberra
Griffith
Fyshwyck
Anthill
Curtin
RED HILL
Red Hill
Federal Golf Course
Hughes
Narrabundah
Lyons
Garran
Cemetery
HINDMARSH DRIVE
YAMBA DRIVE
MELROSE DRIVE
CANBERRA AVENUE
NARRABUNDAH LANE
JERRABOMBERRA AVENUE
Jerrabomberra Creek
MUGGA MUGGA
HUDSON
MAHON
Callum Brae
Chifley
Ford
209
210
211
212
213
215
216
217
218
219
46
45
44
43
42
41
40
39
38
37
36
35
34
33
23

Figure 15.2: Canberra 1: 50,000, contour interval 50 feet (Directorate of Military Survey, Canberra)

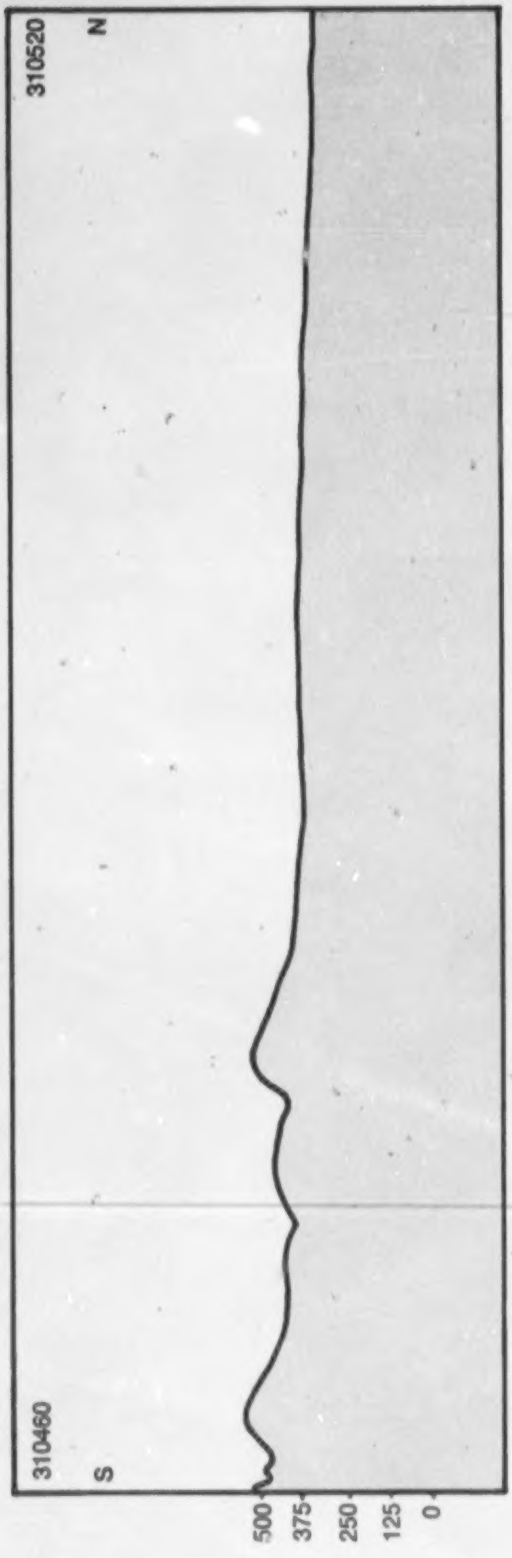


Figure 15.3: Transect from Shepparton map (figure 15.7)

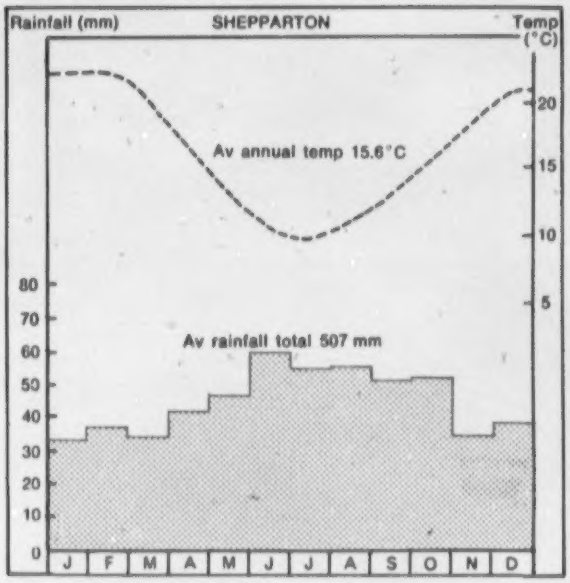


Figure 15.4: Climatic graph, Shepparton (30 year averages)

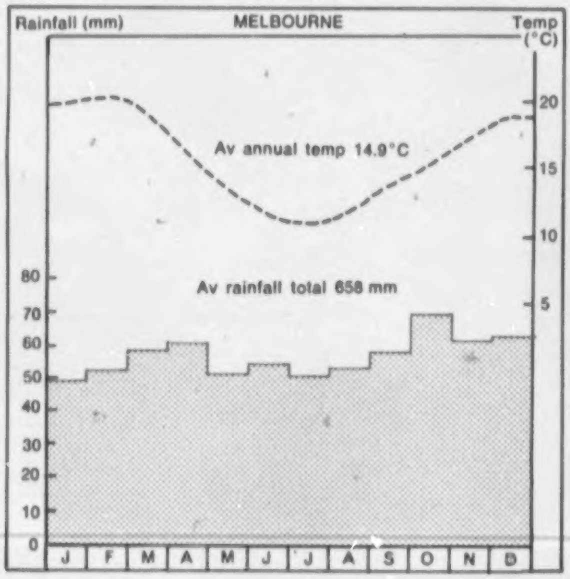


Figure 15.5: Climatic graph, Melbourne (30 year averages)

examples of resources that you have found in this project.

(b) Farms are spatial units or systems in which farmers try to make the best use of the land, and at the same time to have the most efficient use of all the resources involved. Show how a type of farm you have studied tries to make the best and most efficient use of the resources available to it. Use sketches to illustrate your answer.

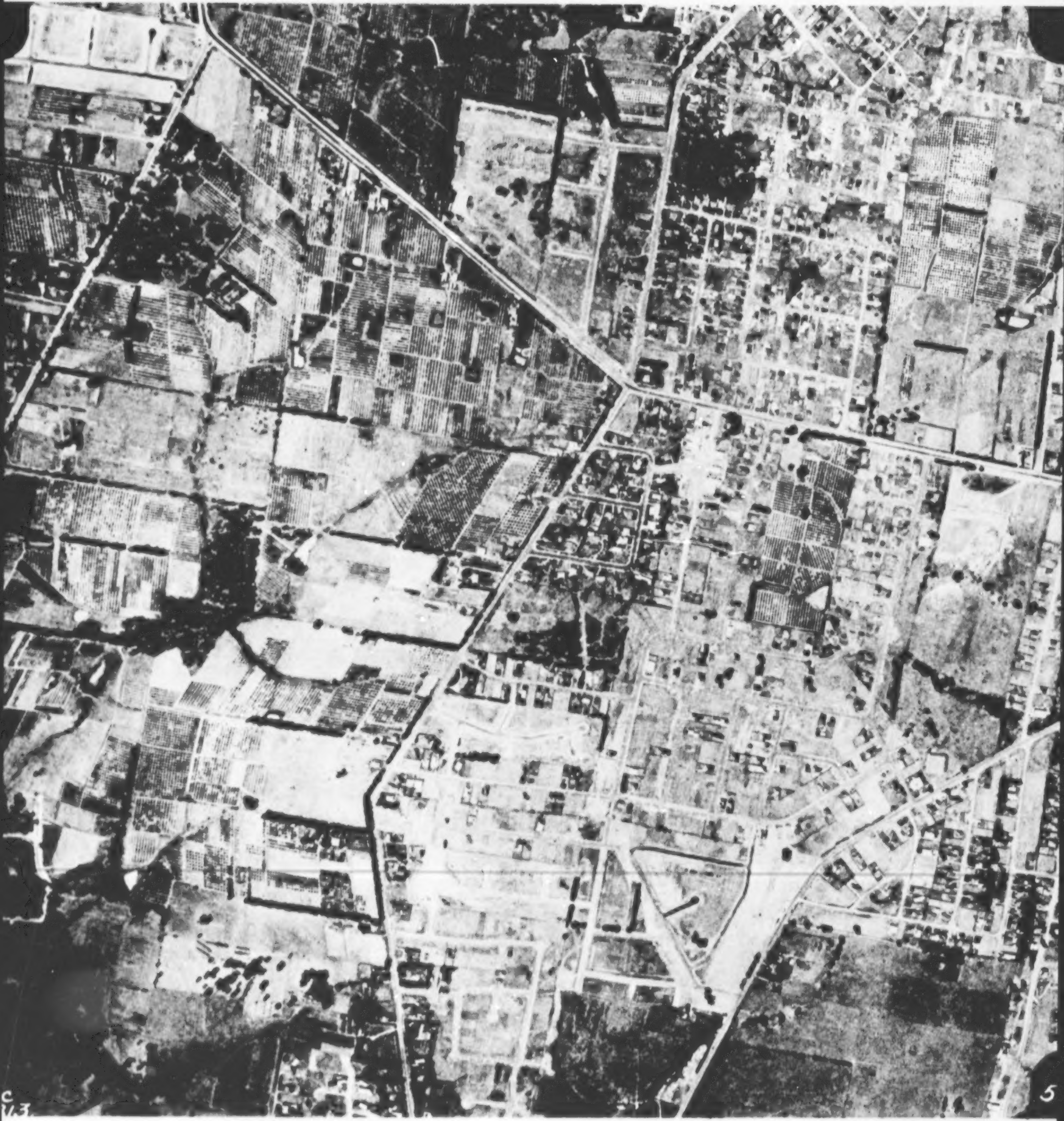


Figure 15.6

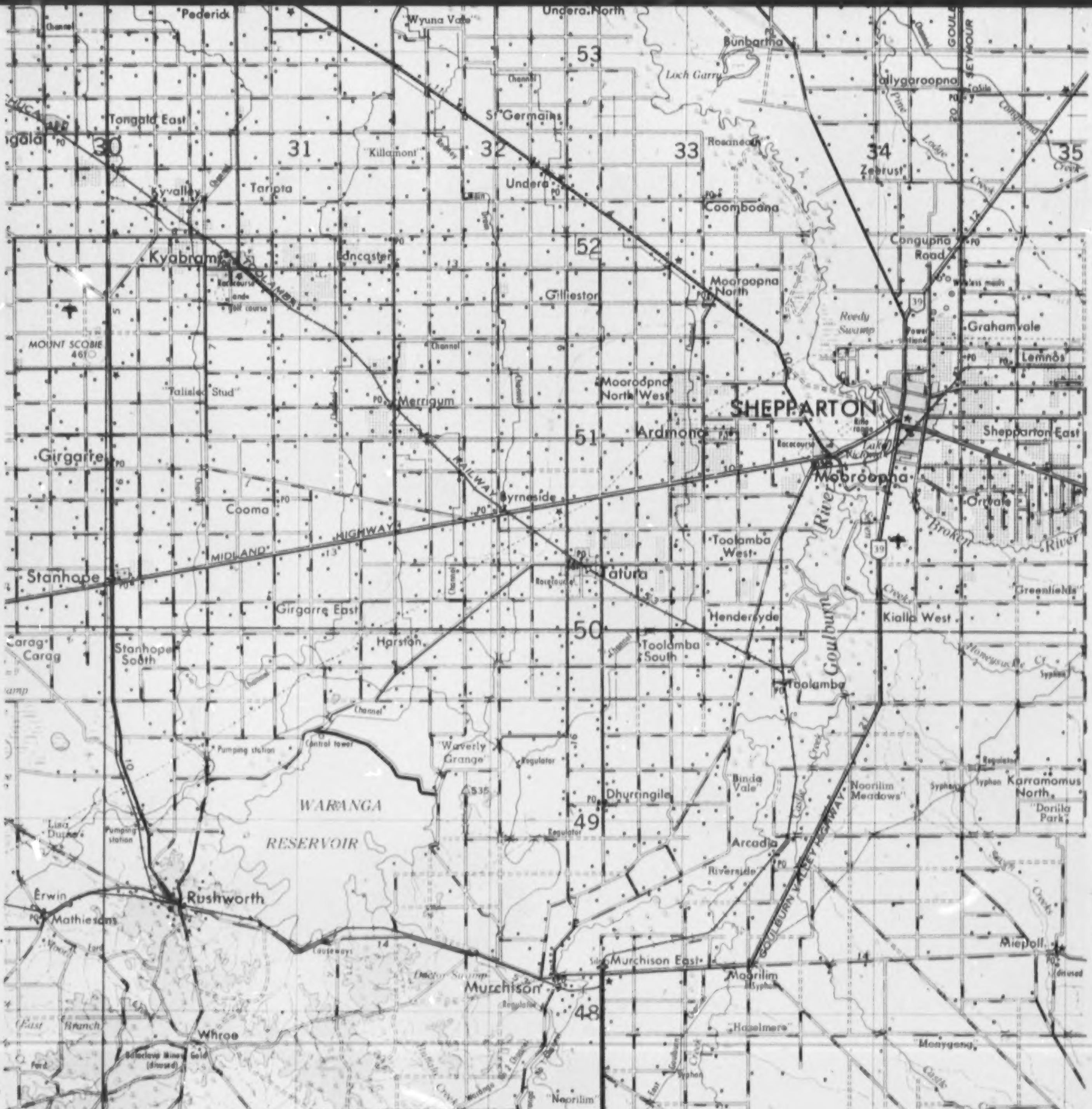

Pederick
"Wyuna Vale"
Undera North
53
Bunbartha
Loch Garry
Tallygaroopna
Tongala East
Tongala
30
31
"Killamont"
32
St Germains
33
"Rosaneath"
34
Zeerust
35
Kyvalley
Taripta
Undera
Coomboona
Kyabram
Lancaster
52
Congupna Road
Mooroopna North
Gillieston
Reedy Swamp
Grahamvale
MOUNT SCOBIE 461
Lemnos
"Talisle Stud"
Merrigum
Mooroopna North West
SHEPPARTON
Ardmona
51
Shepparton East
Girgarre
Mooroopna
Cooma
Byrneside
Orrvale
MIDLAND HIGHWAY
Toolamba West
Broken River
Stanhope
Tatura
Greenfields
Girgarre East
Hendersyde
Kialla West
Carag Carag
Stanhope South
Harston
50
Toolamba South
Goulburn River
Toolamba
"Waverly Grange"
Pumping station
Control tower
Binda Vale
Noorilim Meadows
Karramomus North
"Dorilla Park"
WARANGA
Dhurringile
RESERVOIR
49
"Lisa Dunn"
Arcadia
Riverside
GOULBURN VALLEY HIGHWAY
Erwin
Rushworth
Mathiesons
Murchison East
Moorilim
Miepoll
Murchison
48
"Hazelmere"
Whroe
Moyegang
"Noorilim"
"Wahroa"
Greybrook
Molka
Angustown
"Springfield"
Reedy Lake
Wahring
47
Erena Park
"Castle Park"
STATE FOREST
Baillieston
Baillieston East
GOULBURN WEIR
Pine Grange
"Dryedale"
30
31
32
33
"Norrawa"
34
35
MOUNT BLACK
Nagambie
Koomba
Creighton

Figure 15.7: Shepparton 1 : 250,000 **(Directorate of Military Survey, Canberra)**

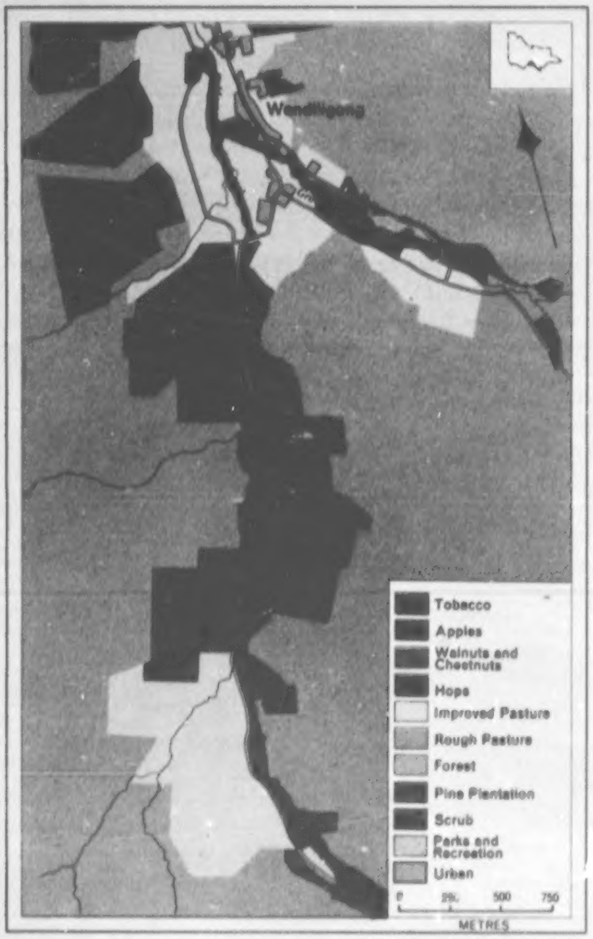

Wandiligong
Tobacco
Apples
Walnuts and Chestnuts
Hops
Improved Pasture
Rough Pasture
Forest
Pine Plantation
Scrub
Parks and Recreation
Urban
0
250
500
750
METRES

Figure 15.8: Ovens Valley land use

EVALUATION

11. (a) Write a few lines describing a mining area you have studied.

(b) What are some of the problems faced by people in mining areas?

(c) Are there any dangers for a country in the mining of its resources?

(d) What are some of the benefits that mining may give to an area?

12. Many industries are very large and sell their products all over Australia. Others are more local industries—printing, bakeries, etc. Describe one of these local industries and try to explain why it is located where it is.

13. Some industries, such as sugar refining and oil refining (figure 15·10), are often located near a port. Suggest why this happens.

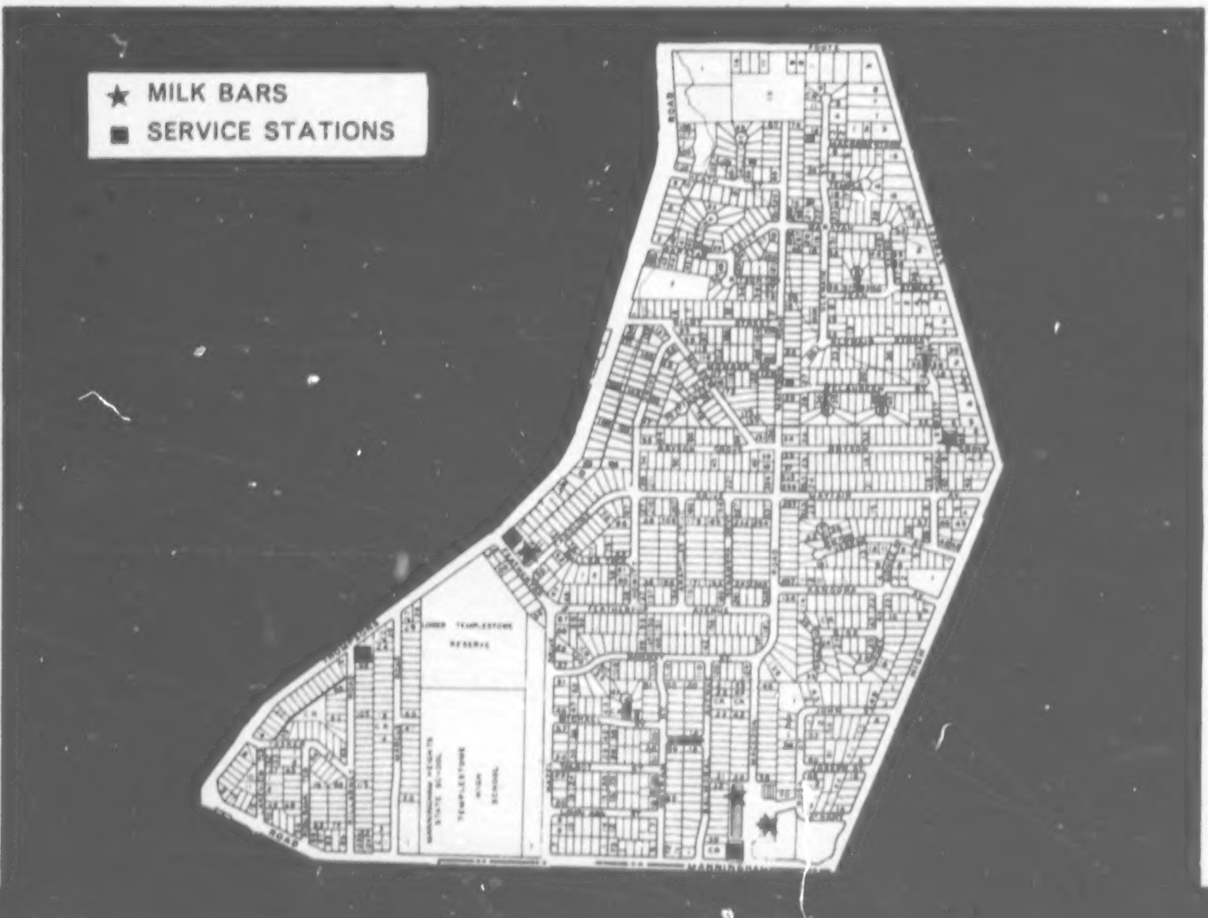
14. Some Melbourne industries, such as the motor vehicle industry, are located some distance from the city centre at Dandenong and Broadmeadows. (See figure 15·11.) Think of reasons for this location pattern.

15. Compare life in a small country town with life in a mining town. Are there any similarities? What are the main differences?

16. Compare life in the swamp area of New Guinea with life on a farm somewhere in Australia. What are the main similarities and differences?

17. In many cities, developers tend to replace

Figure 15.9


★ MILK BARS
■ SERVICE STATIONS
LOWER TEMPLESTOWE RESERVE
TEMPLESTOWE HIGH SCHOOL

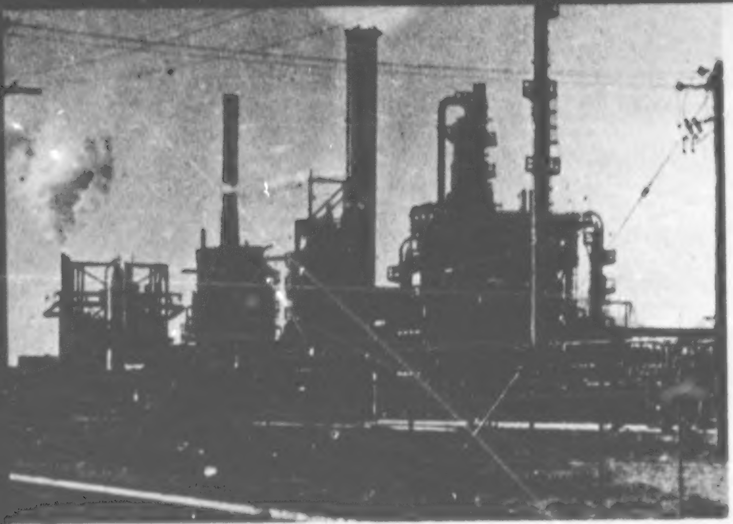


Figure 15.10: Refinery at Altona West

older houses with multi-storey apartment buildings (figure 15·12). Do you think this is a good idea? Give reasons for your answer.

18. An actual distance of 10 km will be the same in Melbourne, in the farming areas of the Shepparton district, and in the swamps of New Guinea, but to the people of these areas it may seem very great or very small. Why should such a distance mean different things to people in different environments?

Figure 15.11: Ford automotive works, Melbourne

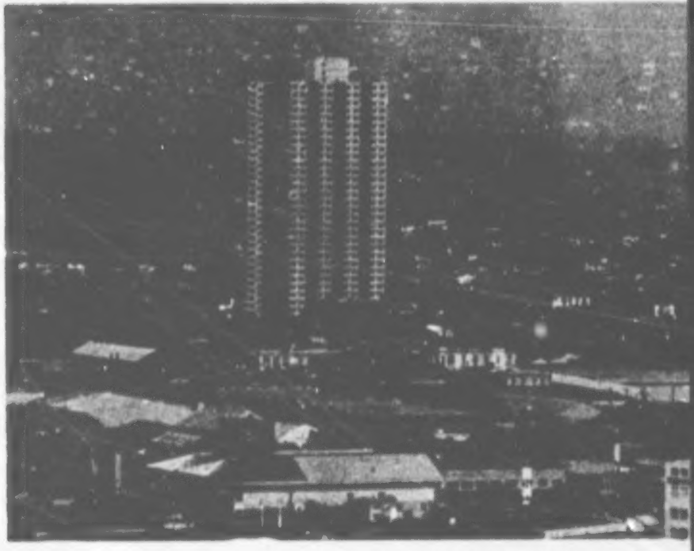
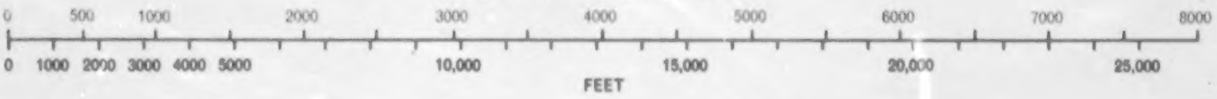


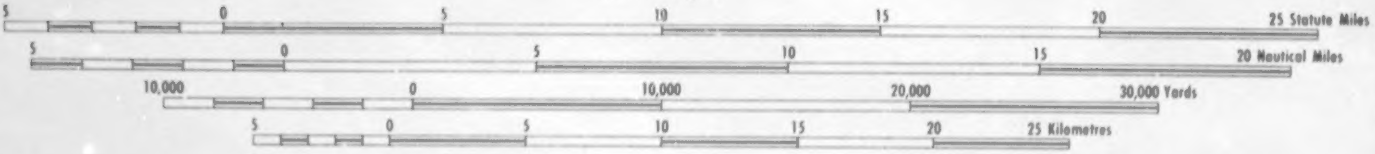
Figure 15.12: High-rise residential development in Melbourne

Appendix


Conversion Scale feet to metres

		Conversion Factors (Approximate)	
Quantity	**Metric unit and symbol**	Imperial to Metric Units	Metric to Imperial Units
Length	millimetre (mm)	1 in = 25.4 mm	1 mm = 0.0394 in
	centimetre (cm, 10 mm)	1 in = 2.54 cm	1 cm = 0.394 in
		1 ft = 30.5 cm	
	metre (m, 100 cm)	1 yd = 0.914 m	1 m = 3.28 ft
	kilometre (km, 1000 m)	1 mile = 1.61 km	1 km = 0.62 mile
Mass (commonly called 'weight')	gram (g)	1 oz = 28.3 g	1 g = 0.0353 oz
	kilogram (kg, 1000 g)	1 lb = 454 g	1 kg = 2.2 lb
		1 stone = 6.35 kg	1 kg = 0.157 stone
	tonne (t, 1000 kg)	1 ton = 1.02 t	1 t = 0.98 ton
Area	square metre (m^2, 10 000 cm^2)	1 ft^2 = 929 cm^2	1 m^2 = 10.8 ft^2
		1 yd^2 = 0.836 m^2	1 m^2 = 1.2 yd^2
		1 perch = 25.3 m^2	1 ha = 9.88 roods
	hectare (ha, 10 000 m^2)	1 acre = 0.405 ha	1 ha = 2.47 acres
	square kilometre (km^2, 1 000 000 m^2, 100 ha)	1 mile^2 = 2.59 km^2	1 km^2 = 0.386 mile^2 = 247 acres
Volume	cubic centimetre (cm^3)	1 in^3 = 16.4 cm^3	1 cm^3 = 0.061 in^3
	cubic metre (m^3, 1 000 000 cm^3)	1 ft^3 = 28 300 cm^3	1 m^3 = 35.3 ft^3
		1 yd^3 = 0.765 m^3	1 m^3 = 1.31 yd^3
		1 bushel = 0.0364 m^3	1 m^3 = 27.5 bushels
Volume (liquids and gases)	millilitre (ml)	1 fl oz = 28.4 ml	1 ml = 0.0352 fl oz
	litre (l, 1000 ml)	1 pint = 568 ml	1 litre = 1.76 pints
	kilolitre (kl, 1000 l, 1 m^3)	1 gal = 4.55 litres	1 kl = 220 gal
Speed	kilometre per hour (km/h)	1 mph = 1.61 km/h	1 km/h = 0.621 mph
Pressure (for meteorology)	millibar (mb, 0:1 kPa)	inch of mercury = 33.9 mb	1000 mb = 29.5 inches of mercury
Energy	kilowatt hour (kWh, 3:6 MJ)	1 therm = 29.3 kWh	1 kWh = 0.034 therm
		1 "gas unit" (1 kWh) = 3.6 MJ	1 MJ = 0.278 kWh = 0.278 "gas unit"
Power	kilowatt (kW)	1 hp = 0.746 kWh	1 kW = 1.34 hp
Temperature	degree Celsius (°C)	$^\circ C = \frac{5}{9} (^\circ F-32)$	$^\circ F = \frac{9 \times {}^\circ C}{5} + 32$

Scale 1:250,000



ELEVATIONS SHOWN IN FEET

LEGEND

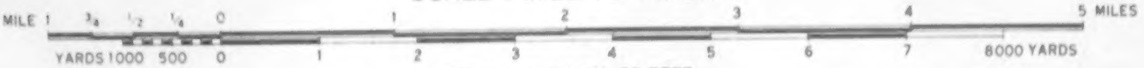
(P.D.) indicates position doubtful
(I.D.) indicates photo interpretation doubtful

Highway; built-up area
Road, sealed surface first class; route marker 79
Road, sealed surface second class; mileage 5
Road, loose surface all weather first class
Road, loose surface all weather second class
Road, loose surface dry weather
Road, unimproved earth
Bridge road; bridge railway
Railway multiple track; station; siding
Railway single track; station with siding
Light railway or tramway
Telephone line; power transmission line
Fence; stone wall, quarry

Mine; windpump; levee or dyke
Building (s); church; school; yard
Post office; wireless transceiver; cemetery PO W/T C
Airport or airfield; landing ground
Control point major, minor; astronomical △ ○ ⊕
Spot elevation in feet; accurate; approximate 750 750
Bench mark; mud; gravel BM·750
Sand; cliffs
Sand ridges; sand dunes
Relief shading
Forest dense; forest medium
Forest coniferous or pine plantation; scrub
Vineyard; orchard or plantation

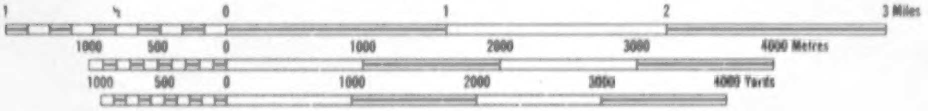
Waterhole; water tank; dam; dry lake
Lake, river or stream perennial
Lake, river or stream intermittent
Dam or weir; falls; rapids
Drain or ditch, perennial; intermittent
Spring perennial, intermittent; ricefields
Marsh or swamp; mangroves
Seaplane anchorage; seaplane base
Breakwater; pier, dock or wharf
Fathom line; low water mark; lighthouse 3 LWM
Wreck sunken, exposed; vessel anchorage
Rocks submerged, bare or awash
Reef, rocky or coral

SCALE 1 MILE TO 1 INCH



CONTOUR INTERVAL 50 FEET

Scale 1:50,000



CONTOUR INTERVAL 50 FEET

Roads — *Fenced* — *Unfenced*
- *First class*
- *Second* "
- *Third* "
- *Fourth* "

Track vehicular
Track foot or pack
Bridge (wood, except where shown as masonry, concrete or iron) M
Culvert, causeway, gate or cattle grid
Railway, double line with stations
Railway with station and siding
Railway, single line with siding
Tramway
Embankment, cutting
Tunnel
Telegraph or telephone line, along road
across country
Electric transmission line, along road
across country
Wireless mast
Lighthouse
Wind pump
Mine
House, shed
School, hotel, post office S H P
Church
Cemetery C
Levees

Quarry
Sand or gravel pit GRAVEL
Aerodrome AERODROME
Fathom line
Low water mark LWM
Wreck
Buoy, beacon or pile light BUOY
Pier, wharf, breakwater
River or perennial stream
Non perennial stream
Canal, channel or drain
Spring, well WELL
Tank or Waterhole, dam
Swamp or marsh
subject to inundation — *permanently inundated*
Sand (foreshore area)
Mud (foreshore area)
Mangroves
Full cover, camouflage cover
Scattered cover, scrub
Rain forest RAIN FOREST
Hedge, line of trees
Pine plantation
Orchard
Vineyard
Contours
Depression contour

INDEX

Bakery 80 ff.
  bread 80
  costs 86
  distribution 85
  factory 85
  raw materials 82
Beef cattle 57 ff.
  Africander-cross 61
  Brahman-cross 61
  meatworks 63
  statistics 57
  transport 63
  Zebu 61
Belmont cattle breeding station 57 ff.
Butterfat 51

Carlton 141
Carnivore 20
Central place 56, 119
Change over time 9
Christmas Island 72 ff.
Climate (tropics) 25
Coral
  damage 20
  polyp 15, 16
  reef 15, 17, 20
Crown-of-thorns starfish 23
Cyclones 20

Dairying 41 ff.
  climate 46, 47
  description 41
  factory location 46
  factory methods 48
  marketing 44 ff.
  milking 52
  soils 49
  stock 51, 52
Desert 7 ff.

Economic reserves 66
Elema 25
Elizabeth (S.A.) 100 ff.
Evaporometer 8
Evaporation 8

Fieldwork 142 ff.
Fitzroy 141
Food chain 20
Forest 27

Garage 90 ff.
Geographers 1, 40
Germinate 8
Gippsland 117
Gold standard 71
Gradient 12
Great Barrier Reef 15, 21
Growing season 46
Guano 76

Hay 48
Herbivore 20
Hinterland 117
Hypotheses 132

Interaction 119
Iron Knob 8

Kerema Bay 25
Kukukuku 25

Land use surveys 142
Locusts 13 ff.
Lower Templestowe 117

Mangroves 17, 27
Market garden 32 ff.
  description 32 ff.
  fertiliser 33, 36
  location 32
  methods 37
Mining 65 ff.
Mirboo North 41
Murua 25

Neighbourhood 98, 117, 119
Newspaper distribution 87 ff.
Nomadic, semi- 25
Norseman 71

Objectives 4, 5

Palm thatch 28
Papua 25
Pasture
  type 48
  management 48
Pesticides 23
Phosphate 72 ff.
Phosphate mining 76, 77
Plankton 16
Plants
  desert 8 ff.
  ephemerals 9, 12
  perennials 9, 12
  swamp 28
Port Alma 64
Processing industry 80 ff.

Rainfall average 8
Rain forest 27
Resource 65
'Robber industry' 65
Rockhampton 57

Sago 28
Sale 117 ff.
Scale 12
Service station 90 ff.
Silage 48
Simulation 2
Streams, intermittent 12
Swamp 25 ff.
System
  balance 20
  definition 1
  farming 32 ff.
  industrial 80 ff.
  mining 65 ff.
  neighbourhood 100 ff.
  service 87 ff.
  subsystem 1

Taro 30
Temperature range 25
Trade area 120
Trade area surveys 145
Traffic surveys 97

Urban neighbourhoods 127 ff.